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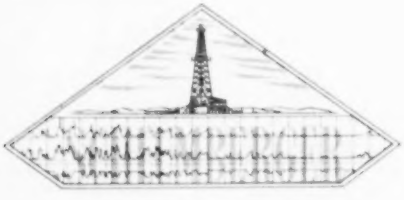
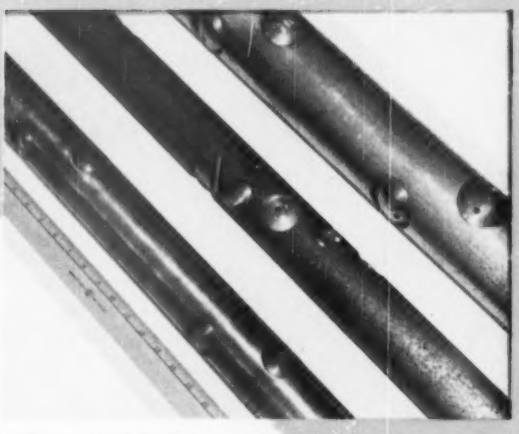
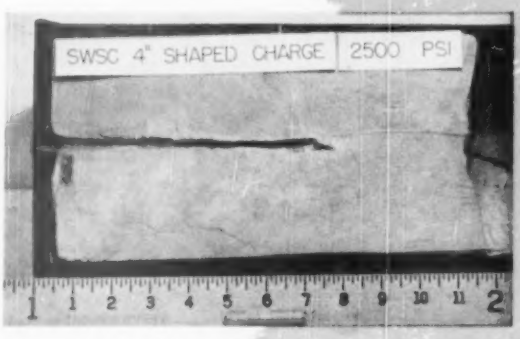




2⅛" carrier, left, 4 shots to the foot; 2⅝" carrier, center, 6 shots to the foot; and 4" carrier, right, 4 shots to the foot.



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Letters...

to the editor

Irving Fatt, author of the letter below, has become this month the lead-off man of a new department in the JOURNAL. We hope that his is only the first of a long line of letters to this column offering constructive criticisms or just chatting with us. Use this department as a megaphone directed at the membership (non-commercial, of course). Read Irving's letter below and let us know what you think. We're asking for it.

To the editor:

I should like to present some of my thinking about ways of improving the JOURNAL OF PETROLEUM TECHNOLOGY (although) I do not fully understand all the difficulties involved in publishing a technical journal. One of my first ideas was to have only original papers published in the JOURNAL. The papers read at various Petroleum Branch meetings would be given circulation only (as) preprints . . . (which) could be advertised in the JOURNAL so that interested persons could obtain copies. This idea stemmed from my dissatisfaction with the present method of publishing papers which were presented as much as a year before. Month after month I open my JOURNAL only to find that all the papers are "old stuff" to me because I have already studied them in the form of preprints.

A policy publishing only original papers . . . means that about 48 additional papers per year would be needed. After (some objection) I modified my ideas and evolved an alternate plan . . . (which) calls for two of the four papers per month to be original . . . never presented previously in any form. This means that some of the papers . . . would have to be put aside in favor of original papers. (But) only about 60 per cent of the papers presented at meetings are now published, and a drop in this percentage to 30 per cent would not cause any great upheaval . . . Authors of papers understand that presentation . . . is no guarantee of publication. Authors who cannot or do not wish to attend the meetings could . . . have their material published. The elimination of the bother of preparing a paper for oral presentation might be an incentive for some men.

(To get more papers) I would suggest that the JOURNAL have representatives in various parts of the country where research laboratories are located. These men . . . could promote the writing of papers for the JOURNAL. I do not believe the JOURNAL is now publishing the results of a great deal of interesting research . . . in university laboratories. . . The JOURNAL need not restrict itself to petroleum reservoir engineering but should also report . . . fundamental research in physics and chemistry (with) a direct bearing on petroleum engineering or petroleum geology problems. In this category I would put research on surface effects, viscosity, geochemistry, and fluid mechanics. . . .

Irving Fatt
California Research Corp.
La Habra, Calif.

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TABLE OF CONTENTS

Editorial Features — Section 1

Editorial: Toward a Better Understanding of Engineering Education, by John C. Calhoun 7
Mounting Core Analysis Specimens in Thermoplastics, by W. E. Showalter 8
Technical Note — Some Controlling Factors Regarding Variable Weighting of Cement Slurries, by M. A. Mallinger 10
Engineering Developments in Local Sections 12

Petroleum Transactions

Performance of the Lower Pawelek Reservoir, Falls City Field, Karnes County, Texas, by John W. Crutchfield and Emil F. Bowers 335
Correlation of Bottom Hole Sample Data, by Guy Borden, Jr., and Michael J. Rzasa 345
The Effect of Permeability Stratification in Complete Water-Drive Systems, by Morris Muskat 349
Index to Transactions, 1950 359

1949 Production Statistics

Oil and Gas Developments in Alabama, Georgia and Florida, by James Proctor 321
Oil and Gas Developments in Mississippi, by H. M. Morse and James Proctor 323
Oil and Gas Developments in Michigan, by R. P. Grant 329
Oil and Gas Developments in the Rocky Mountain Region, by Raymond M. Larsen 343
Oil and Gas Developments in the Texas Panhandle Region, by J. F. Dougherty 368
Oil and Gas Developments in the Hugoton Area, by J. F. Dougherty 373
Oil and Gas Developments in the Pacific Coast Area, by L. E. Porter and L. W. Chasteen 374
Oil and Gas Developments in West Virginia 398
Oil and Gas Developments in Foreign Fields 400
Index to 1949 Production Statistics 456

Institute Affairs — Section 2

Drift of Things, by Edward H. Robie . . . 1
Membership 2
Meeting Calendar 8
Personals 2
Employment Notices 6
Advertisers' Index 8

On the Cover — December is the month for Christmas trees and the cover of the JOURNAL would look out of step without one. Here is our own particular variety of "Christmas tree" — one marking a producing well in a Western Canada field covered with December snow and winter twilight. Photo by Imperial Oil Ltd.

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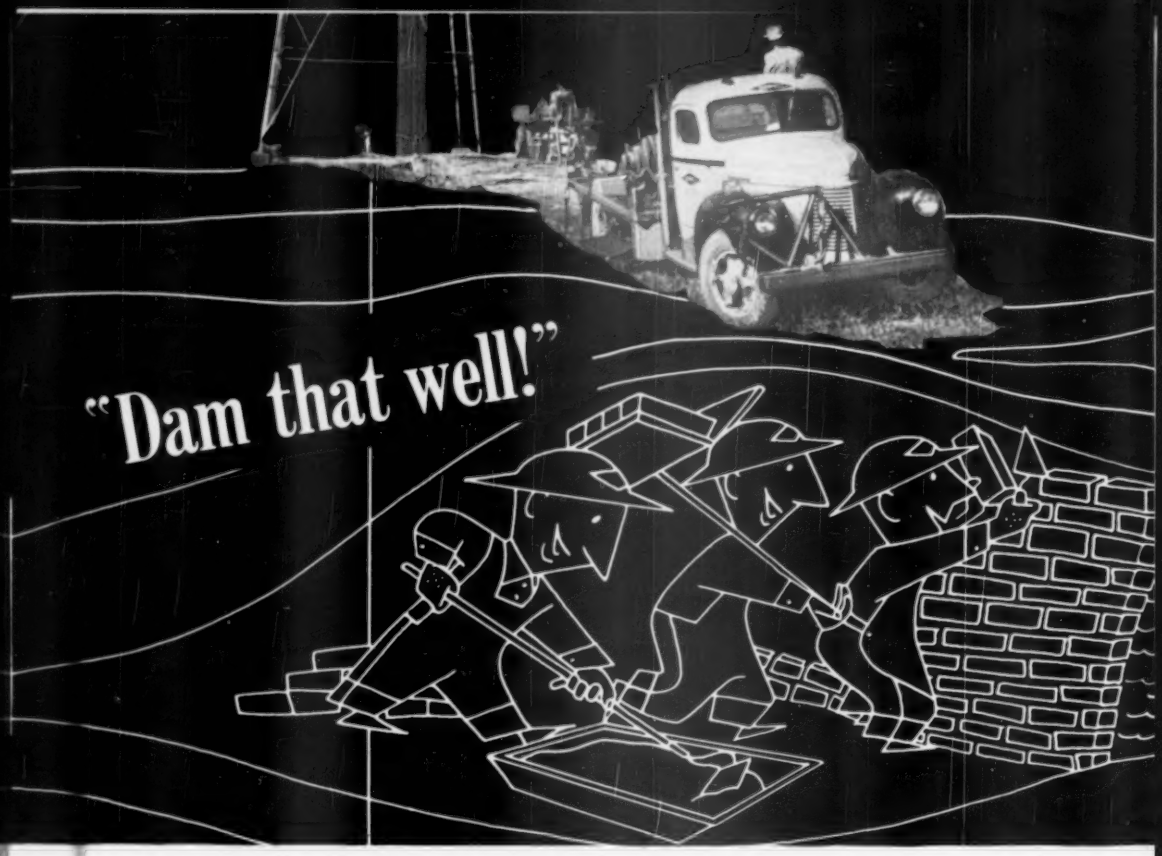

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Editorial Comment—

TOWARD A BETTER UNDERSTANDING OF ENGINEERING EDUCATION

By John C. Calhoun
Pennsylvania State College

MUCH is being spoken and written these days concerning education, and particularly concerning engineering education. It has been said that our recent struggle and present world unrest result from the acquisition of tools of destruction for which our society has been unprepared. For this situation the engineer and technologist have been roundly criticized.

The engineer has been taken to task for not having a broad or liberal education, for not being aware of the social responsibilities of his profession and for being only a specialist.

So much in this vein has been spoken that engineers have developed a group inferiority complex. They have been too willing to accept without argument the accusations leveled against them. The present discussion is devoted to the twofold proposition that engineers or technologists are no more to blame than members of any other profession for the present state of affairs, and that engineering educational programs have more of those aspects being stated today as desirable than do most other programs. These propositions are presented as a vote of confidence in the program of engineering education, with the hope that many of the fine things contained therein will not be thrown away in the face of extensive reactionary criticism.

In arguing these propositions, it is necessary to inquire what education is and what functions it should perform. In a broad sense, education is a synonym of life. An individual's education is the sum total of all his experiences. Whether these experiences be in school or out, whether they be in terms of actions, words, ideas, or writings, and whether they be gained through a formal or informal process is immaterial. It is impossible to divorce one contact from another and to say that one portion of a man's life is his education and another portion is not.

IN A more limited sense, education encompasses those experiences during which a man is guided in understanding his environment by being brought into contact with the experiences of others. Education so defined is still too broad to include both a formal schooling and informal education. In a still more limited sense, education connotes that particular guidance and instruction received during the interval of time when the individual is laying the groundwork for his career. This training is usually received in a formal program at a school or university.

However, the formal educational process is only part of the individual's greater scope of experiences during the same interval of time, and it must be closely integrated with the total experiences. This integrating process is the key to a successful educational system, and is the quality which leads to the designation of a liberal education.

The concept of a liberal or broad education, although open to much criticism and discussion, has been generally misunderstood. Prevalent misconceptions are that a specialist cannot have a liberal education, that a liberal education is synonomous with knowledge in areas of general interest to all, and that a liberal education is indicated by a facility of speech.

A specialist in the arts, for example, may be judged to have a broad education, because he speaks on a subject to which all have been exposed and in which most can follow to a limited extent. On the other hand, a specialist in a technology may be judged to lack a broad education because he speaks on a subject to which few have been exposed and in which few can follow. A specialist may or may not have a broad education, a judgment which must be based on considerations other than his field of specialization.

On the other extreme, the acquisition of knowledge in many areas does not guarantee a broad education. This is often a sign that an individual has an encyclopedic mind capable of retaining many facts, or an indication that he has shallowly ploughed many fields without successfully producing a crop in any one. Although it may be true that a broadly educated person acquires knowledge in many areas, the inverse does not follow.

A LIBERAL education is in fact the development of a state of mind. It is possessed by a man who has the capacity to accept new ideas upon demonstration of fact and analysis and who understands how his own special field of knowledge fits into the whole. It is acquired not so much by exposure to a wide variety of facts and interests as it is by a disciplinary process through the proper handling of a few facts and interests.

The objectives of formal education can be stated in terms of the qualities that are desired in the student when he has finished his formal education. These are civic responsibility, the capacity to work and the ability to produce, and the ability to communicate.

Civic responsibility defines the individual's relationship to his fellow man and to society as a whole, and his attitude toward himself. It includes his behavior in all groups of society — within his profession, within his state and national community, within world society or within any group with which he may affiliate. Many critics in their arguments have stated the attainment of civic responsibility to be the sole aim of formal education. Some have stated that the sole responsibility toward developing this quality lies with the educational institution. Neither of these concepts is correct. The development of civic responsibility is a function not of the educational system alone, but of the individual's home, church, and political environments. To lay the entire blame for good or bad

Continued on Page 3, Section 2

Mounting Core Analysis Specimens In Thermoplastic

By W. E. Showalter

Union Oil Co. of California

THIS article presents an improved technique of mounting oil well core specimens in thermoplastic resin. Both consolidated and unconsolidated specimens can be successfully handled by this method, and the process greatly simplifies many core mounting problems.

As the technology of core analysis has progressed, there has developed a need for some good method of mounting core specimens for use in fluid flow investigations. Various methods have been devised in the past, but each has had certain disadvantages and only limited usefulness. These deficiencies have hampered many of the investigations and have often thwarted fundamentally simple tests.

A technique is described which permits the application of thermoplastic resins to almost all samples normally encountered and at temperatures only slightly above the thermal yield point of the plastic and at relatively low pressures. Of equal importance is the fact that the technique is not unduly tedious and can be carried out with a minimum of specialized equipment. An important advantage of this technique is that although the plastic prevents by-passing down the periphery of the sample by squeezing into the exterior indentations, an insignificant penetration of the pores occurs.

The procedure for making such mountings may be summarized as follows: The rock specimen is hermetically sealed into a snug-fitting thermo-plastic container, placed in a temperature-pressure bath, and maintained at an elevated temperature and pressure until the softened plastic is firmly bonded to the rock. As the softened plastic shrinks around the rock and penetrates into the outer layer of sand grains, the excess air within the plastic container is compressed and forced into the interstices of the rock. After sufficient time has elapsed, the bath is first cooled, then depressured, and the specimen removed. Specimens with all degrees of hardness and consolidation may be mounted in this manner, and the shape or size of the specimen is not important. Crushed or broken specimens rarely result because they are not subjected to excessive or unequal mechanical strain during the mounting process. The slight strain that is applied to the rock is uniform in all directions and is cushioned by the layer of softened plastic that completely surrounds the specimen. The importance of this cushioning effect is emphasized by the fact that the plastic does not start to press against the specimen until it has been softened due to heating.

Unconsolidated sands and graded crushed rock may also be mounted for testing by this technique. Specimens mounted in this way may be used for a variety of tests including the determination of permeability, porosity, resistivity, interstitial water, water flooding, gas depletion, and similar studies. The usefulness of the specimens is limited only by the ingenuity of the individual using them. Various items such as metal end plates, porcelain end plates, porcelain annular rings, wire coils, electrodes, etc., may be mounted with the specimen, thereby greatly simplifying many of the setups for specialized testing.

Mounting Consolidated Specimens in Lucite Plastic

The procedure which we have found to be most satisfactory when mounting consolidated specimens in Lucite plastic is generally as follows: Shape specimen to desired form and cement, together with any attached devices, into plastic container which has been machined to a snug fit. (See Fig. 4.) Place the hermetically sealed, plastic enclosed specimen in a pressure temperature bath, such as shown in Fig. 3, and elevate the pressure to approximately 500 psig and the temperature to about 250°F. These pressures and temperatures are optimum only and it may be desirable to deviate from them under special conditions. Maintain the specimen under these conditions for approximately four hours and then cool the bath but maintain the pressure. When the specimen is cool the pressure may be released, the specimen removed and machined and polished as desired.

Examination will show that the plastic bonds to the sand firmly and to a depth of approximately one-half grain diameter. If a mounting is cut open and the sand removed, it will be found that a single layer of sand adheres to the plastic.

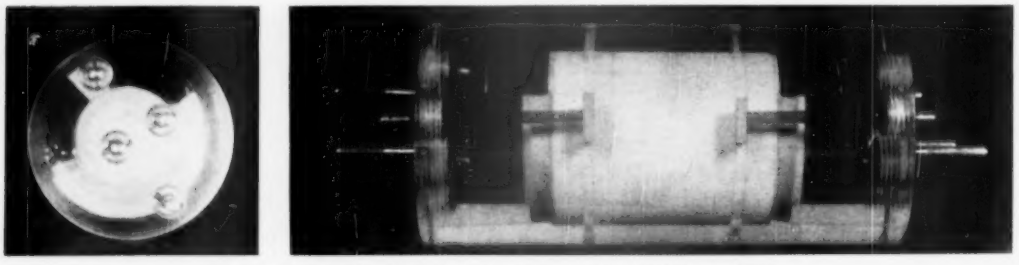

FIG. 1 — SYNTHETIC CORE MOUNTED IN LUCITE FOR RELATIVE PERMEABILITY STUDIES.

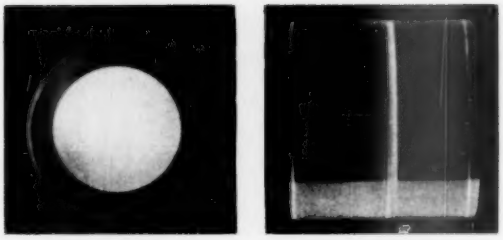

FIG. 2 — CRUSHED QUARTZ THIN SECTION MOUNTED IN LUCITE.

If it is desirable to fully open the ends of the specimen, this may be done by mounting the specimen with a disk of blotting paper over each end. Machine away the plastic to the blotting paper and lift out the disk. By proceeding in this manner the dimensions of the sample are not altered in the process of fully opening the ends.

Mounting Unconsolidated Specimens in Lucite Plastic

When mounting unconsolidated specimens the procedure is the same except that the sand is poured into the plastic cup and tamped by tapping the side of the cup. The degree of this mechanical tamping does not appear to be too important as the sand is finally compacted by pressure on the heat softened plastic.

After the lid has been cemented in place, the plastic enclosed specimen should be supported longitudinally in some manner. One good method of obtaining longitudinal support is to slip the plastic-enclosed sand in a tight-fitting mailing tube. This will prevent the specimen from assuming a longitudinal sag as the plastic softens when heated.

Equipment Required

The items of equipment required to mount cores in this way are standard items in many laboratories. The so-called pressure temperature bath can consist of a steam jacketed pressure vessel, or equivalent, designed for 500 psi internal pressure. (Fig. 3.) It is helpful to have this vessel equipped with some type of quickly removable lid, although an ordinary flanged lid is satisfactory but more tedious to use.

A convenient source of pressure for small equipment is a nitrogen cylinder with a regulator that will supply nitrogen at 500 psi. Bottled nitrogen is probably the best source of pressure as it is both convenient and inert.

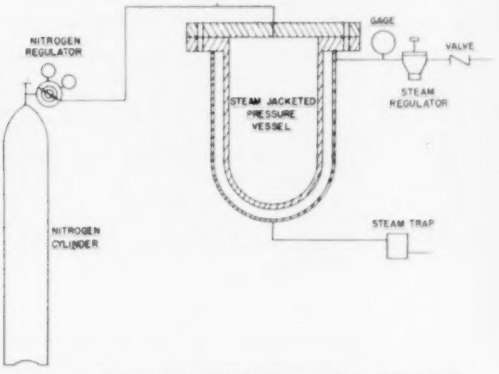

FIG. 3 — SCHEMATIC DRAWING PRESSURE TEMPERATURE BATH.

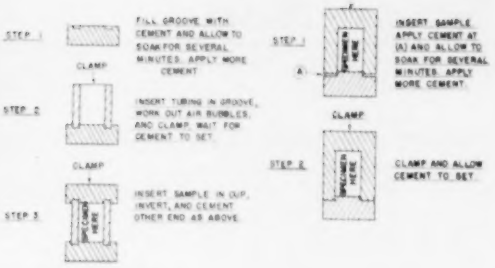
STEP 1
FILL GROOVE WITH CEMENT AND ALLOW TO SOAK FOR SEVERAL MINUTES. APPLY MORE CEMENT
CLAMP
STEP 2
INSERT TUBING IN GROOVE, WORK OUT AIR BUBBLES, AND CLAMP. WAIT FOR CEMENT TO SET.
CLAMP
STEP 3
INSERT SAMPLE IN CUP, INVERT, AND CEMENT OTHER END AS ABOVE.
NOTE THAT ASSEMBLY IS ALWAYS CLAMPED WITH CEMENTED PORTION DOWN SO CEMENT CAN NOT RUN ON TO ROCK SPECIMEN.
STEP 1
A
INSERT SAMPLE. APPLY CEMENT AT (A) AND ALLOW TO SOAK FOR SEVERAL MINUTES. APPLY MORE CEMENT.
CLAMP
STEP 2
CLAMP AND ALLOW CEMENT TO SET.

FIG. 4 — METHODS OF CEMENTING SPECIMENS IN PLASTIC CUPS.

Miscellaneous

The same technique can be used for mounting ceramic membranes for use in capillary desaturation or relative permeability tests. It obviates the necessity of using cement to seal the porcelain membranes in place. A piece of highly permeable sintered glass may be mounted adjacent to each piece of porcelain to distribute fluid from flow line to porcelain.

Many fluid flow determinations may be simplified by mounting the test specimen in plastic instead of using a cell.

Conclusions

In conclusion, it should be observed that this technique is not a radical departure from customary methods, but is believed to be a more convenient procedure and circumvents the excessive pressures and temperatures placed upon the sample by methods of handling involving the casting of plastic about the sample. It has proved to be very useful, and will undoubtedly find wider application as new and more desirable thermoplastics become available. ★ ★ ★

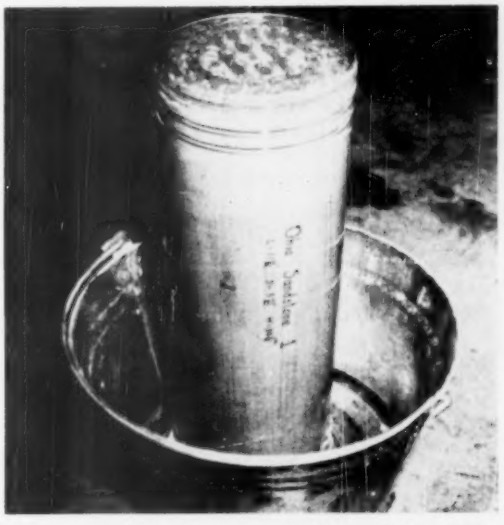

FIG. 5 — LARGE OHIO SANDSTONE CYLINDER MOUNTED IN LUCITE.

SOME CONTROLLING FACTORS REGARDING VARIABLE WEIGHTING OF CEMENT SLURRIES

M. A. MALLINGER, STANOLIND OIL AND GAS CO., TULSA, OKLA.

ABSTRACT

A series of laboratory tests was conducted to determine the limits of practicability in regulating the weights of various cement slurries. It was found that slurry weights of 12 to 19 lb per gallon could be obtained by adding bentonite to decrease the weight and barytes ore to increase the weight. It was also found that barytes ore was not usable in all cements.

LIGHTWEIGHT CEMENT SLURRIES

INTRODUCTION

During the drilling and completion of oil wells the magnitude of the hydraulic pressures exerted on certain formations is critical. In many cases considerable care must be exercised to prevent drilling mud weights from becoming too high, and in those wells where loss of circulation is a problem, the use of normal weight cement slurries will generally result in lost returns during casing cementing operations. While mud weights can easily be controlled, it is necessary to exercise care in the selection of weight reducing additives for cement slurries in order that slurry weights may be reduced sufficiently to prevent the loss of a large portion of the cement to the thief formations without seriously affecting the setting properties of the cement.

EXPERIMENTAL RESULTS

An extensive search revealed that a large number of materials that might have been otherwise practicable as a weight reducing additive were not acceptable for use with oil well cements because the imposition of pressure on the slurries caused the additive being tested to be compressed or to absorb water from the slurries, resulting in negligible decrease in the slurry weight.

This search for lightweight additives disclosed that bentonite, a material very commonly used for reducing the weight of drilling muds and cements, produced the best results without undue harmful effects on the properties of oil well cements. It was found that there was a limit to the amount of bentonite that could be used, but that this limit was, in many cases, considerably higher than is generally believed practicable.

In the evaluation of bentonite as a slurry weight reducing additive, the following characteristics were analyzed: Effect on slurry weight; effect on strength; effect on pumping time; effect on porosity and permeability.

(1) *Slurry Weight* — The slurry weights of all brands of cements were proportionally decreased by the addition of bentonite. Fig. 1 illustrates the weight reductions that can be accomplished in five different cements by adding increasing amounts of bentonite. These slurry weights could not be altered by the imposition of 10,000 psi pressure on the slurry.

(2) *Strength* — In the determination of the maximum allowable per cent bentonite that can be added to cement, a tensile strength development of 100 psi in 24 hours was selected as the minimum strength acceptable.

Strength tests at curing temperatures from 80°F to 200°F were conducted on all of the cement-bentonite mixtures shown

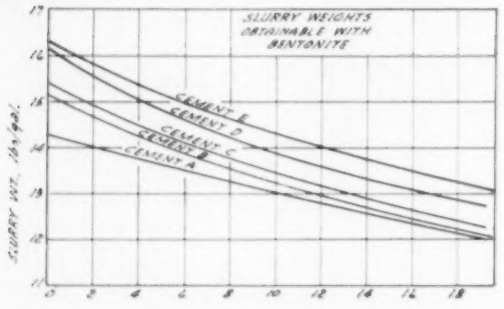

FIG. 1 — PER CENT BENTONITE BY WEIGHT OF CEMENT.

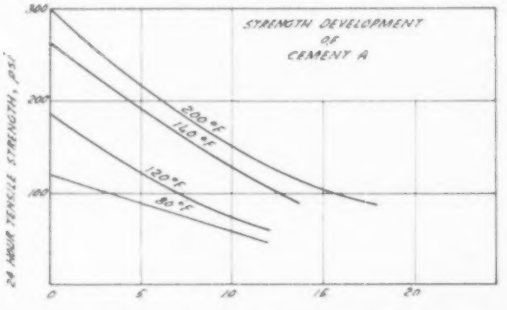

FIG. 2 — PER CENT BENTONITE BY WEIGHT OF CEMENT.

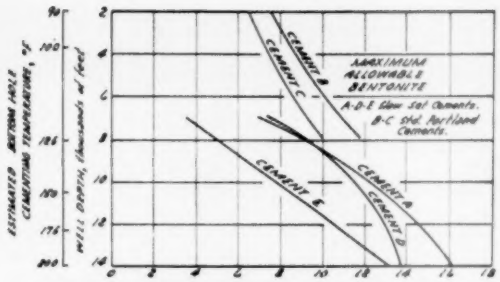

FIG. 3 — MAXIMUM ALLOWABLE PER CENT BENTONITE.

in Fig. 1. Fig. 2 is a plot of the data obtained on one cement and is typical of the curves plotted for each cement evaluated. These curves serve as an indication of the maximum amount of bentonite that can be safely used at various curing temperatures. The maximum usable per cent bentonite for each curing temperature can be determined in Fig. 2 by reading the abscissa at the intersection of each temperature curve and the 100 psi ordinate. By the use of this type of plot and by substituting well depth for temperature, it was possible to determine the maximum allowable per cent bentonite that could be used in any cement at any depth. Fig. 3 is a geographical presentation of these data.

(3) *Pumping Time* — Stirring time tests conducted on the high pressure Stanolind Pressure Thickening Time Tester (API Code 32, Tentative), a machine which measures the consistency and pumping time of cement slurries at pressures and temperatures comparable to those encountered at any well depth, indicated that the pumping time of cement slurries was neither increased nor decreased by the addition of any operable amount (see Fig. 3) of bentonite, if the initial consistency of the slurry containing bentonite was the same as a slurry of the same cement with no bentonite. This indicates that the bentonite, when used as recommended, has little or no retarding or accelerating effect on the pumping time of cement slurries.

(4) *Porosity and Permeability* — The effect of the addition of bentonite to cement slurries on the porosity and permeability of the set cement was determined by adding various quantities of bentonite to several cement slurries, allowing the samples to cure and measuring the porosity and permeability of the set cement-bentonite samples. It was found that both the porosity and permeability of the set cement did increase with the addition of bentonite, however, the permeabilities, even with the highest percentages of bentonite, were less than one millidarcy. The permeability measurements were all made with air as the flowing medium in order to evaluate the most severe conditions. It is believed that the permeability of this cement to water would be even lower. The porosities reached a figure as high as 55 per cent; however, it is believed that this factor has no detrimental effect on set cement other than to result in a reduction in strength, which characteristic was thoroughly investigated. Fig. 4 illustrates the porosity and permeability values of a typical bentonite cement.

With the specific gravity of dry bentonite approximately 2.7, it is believed that its lightweight producing qualities are a result of the ability of the bentonite to absorb large quantities of water, and it is the addition of this extra water which is directly responsible for reducing slurry weights. The amount of water, over and above the volume normally used for mixing cement, that should be added to the slurry for the purpose of wetting the bentonite is .34 gal per sack of cement per per cent bentonite. For example, when using 3 per cent bentonite the water-cement ratio should be increased 1.02 gal per sack over that normally used for the neat cement. With water-cement ratios increased by this factor the lightweight slurries should have consistencies approximately equal to the consistency of the neat cement slurry.

SUMMARY

Lightweight bentonite-cement slurries containing up to 12 per cent bentonite have been tested successfully in the field. There have been no unsuccessful jobs contributable to the cement and, in some areas, tests indicate that the use of a high bentonite-cement is the only method that can be used which will insure returns throughout the cementing operation.

HEAVYWEIGHT CEMENT SLURRIES

INTRODUCTION

Recently deeper wells have been requiring heavier muds and, consequently, a need is anticipated for heavier cement slurries. At present there is only a limited demand for slurries heavier than can be obtained with neat cement. The greatest application is anticipated in plug back jobs in which 17 lb per gallon or heavier mud must be used. In these plug back jobs a cement as heavy as mud is desirable in order to eliminate the tendency of the cement to float in the mud. It is visualized that, as wells are drilled deeper and deeper, the higher formation pressures encountered will require that heavier slurries than are obtainable with neat cement be required in casing cementing operations in order to eliminate the hazard of a blowout during the operation.

EXPERIMENTAL RESULTS

The most practicable additive found to date for increasing cement slurry weights is barytes ore; however, care must be exercised in the selection of the cement to be used with this ore because the setting characteristics of many cements are unfavorably affected by the addition of large quantities of this ore. A study of Table I will reveal that slurry weights and strength development vary widely with different brands of cement. It is pointed out that this wide variation is caused by the large quantities of ore that are needed, as compared with the relatively small quantities of bentonite used in lightweight slurries, therefore, the effect of the additive on different cements is greatly magnified. Cement "F," for example, in Table I is usable at any depth with 100 per cent ore, while Cement "G" can only be used at much greater depths. Cement

Continued on Page 5, Section 2

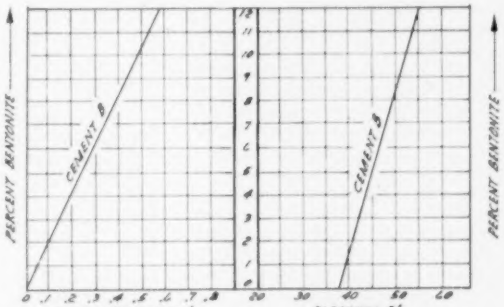

FIG. 4 — EFFECT OF BENTONITE ON THE POROSITY AND PERMEABILITY OF SET CEMENT.

NORTH TEXAS SECTION

Strata-Lift and Channeling Acid

By Kenneth F. Anderson

Almost 100 members and guests of the North Texas Section attended a meeting in the Blackstone Hotel, Fort Worth, on October 30, to hear J. C. McCormick, engineer for Dowell Incorporated, Tulsa, Okla., discuss Strata-Lift and channeling acid.

McCormick pointed out that any underground formation can be lifted or fractured if sufficient pressure is exerted against it, and the pressure required for such a disruption is assumed to be approximately equal to the weight of the overburden. Strata-Lift, trade name for one method of making this underground fracture, is a process in which thickened hydrochloric acid is used as the injection or pressure transmitting fluid. Reasons for using this material are that the viscosity of the fluid is subject to accurate control and that it reverts to a thin, free-flowing medium in a matter of a few hours without the addition of other solutions; that the fluid, being acid, has some solvent effect upon most formations, increasing to that extent the size of the fracture; and that the well may be opened immediately after treatment.

The Strata-Lift technique has been successfully applied to sand, sandy limestone, and limestone formations with sustained production increases, and experience has shown that the best results can be expected from wells having low initial production rates and requiring high fluid injection pressure. Conditions which might be considered unfavorable to the Strata-Lift technique are usually found in wells with high initial production rates, high water-oil ratios, high gas-oil ratios, or wells with exposed shale beds within the formation.

The use of auxiliary hydrochloric acid having the same concentration and employing the same additives as that recommended in the conventional acidizing of the formation concerned is normally recommended following the injection of the thickened acid.

Channeling acid has been designed primarily for the retreatment of previously acidized wells. This acid contains a special additive which causes a coating to be formed on the rock formation. This coating resists further action by the acid, thereby causing the acid to advance through the formation, creating long, narrow tubes or channels within the rock. Channeling acid is always followed by auxiliary acid so that the protective coating will be dissolved and the long, narrow tubes or channels enlarged.

In conclusion, McCormick emphasized that each job is a special problem regardless of whether the Strata-Lift technique or channeling acid is being considered. He recommended that the procedure, the amount and type of agents to be used, and the incidental well preparations should each be carefully determined before a job is begun.

Preceding McCormick's speech, Roland Gouldy, chairman of the Section, led a discusion of business affairs during which Kenneth F. Anderson, chairman of the auditing committee, gave a summary of the financial conditions of the North Texas Section and Gouldy gave a resumé of the national chapter's financial status. These officers were elected by acclamation to serve during the coming year: chairman, Jack A. Crichton, Dallas; vice chairman (Dallas), K. Marshall Fagin; vice chairman (Fort Worth), Gus Athanas; vice chairman (Wichita Falls), Earl C. Taylor, Jr.; secretary-treasurer, Kenneth F. Anderson, Dallas; directors, W. E. Stiles, Dallas; Pat Reardon, Fort Worth; R. G. Parker, Wichita Falls; Joab B. Harrell, Jr., Eastland; and Gordon R. Stine, Wichita Falls. ★ ★ ★

SAN JOAQUIN VALLEY SECTION

MicroLogging in California

By M. C. Eastman

Milton E. Loy, assistant manager in California of the Schlumberger Corp., was principal speaker at the San Joaquin Valley Section's first meeting of the 1950-51 season on November 2. He described the use of the MicroLog, with emphasis on its application in California.

Meeting Notice

Notice is hereby given that the Annual Business Meeting of the AIME will be held at the Hotel Jefferson, St. Louis, at 4 p.m. Tuesday, Feb. 20, 1951. The newly elected directors and officers assume their duties at this meeting. A report of the financial condition of the Institute will be made, as well as reports of the principal officers and standing committees. All AIME members are invited to be present. Immediately afterward, at 5 p.m., the new Board will meet in executive session. ★ ★ ★

In conventional electrical logging the spontaneous potential log is used to delineate the permeable bed. When the formations are much more resistive than the mud (for example, limestone formations and wells drilled with salty muds), or in the case of interbedded zones, the SP is quite rounded. In these cases the SP log generally gives the approximate location of the permeable zones, but it cannot be used for an accurate determination of the boundaries of each permeable bed.

The MicroLog has been developed primarily as a means for the accurate determination of the permeable beds where the SP alone does not give a satisfactory answer. The MicroLog at the present time consists of two short spacing resistivity curves, a 2-in. Normal and a 1½-in. Lateral. The electrodes are mounted in a rubber pad and by a suitable spring assembly the pad is applied to the wall of the bore hole. This pad application is essential

Continued on Page 7, Section 2

PACIFIC TECHNOLOGY GROUP

Field Problems Involved In Water Injection For Secondary Recovery

By N. van Wingen

The seventh lecture of the current AIME series on secondary recovery was given by E. C. Babson, of the Union Oil Co. of Calif., on October 23, 1950, at the General Petroleum Auditorium in Los Angeles.

Babson pointed out that there are currently 13 water injection projects in operation in California. Seven of these are strictly for the purpose of secondary recovery while six are water disposal projects. The principal field problems involved in any water injection plan concern (1) source of water, (2) water treatment, (3) method of injection, and (4) injection well performance.

Availability of water is a problem in many California areas because of the semi-arid climatic conditions. Furthermore, in those instances where surface or shallow well waters are available, they are often not suitable for injection purposes as their chemical composition may be such as to cause a serious loss of sand permeability due to interaction of the water with the sand (clay hydration) or because of the formation of precipitates resulting from a reaction of the injection with the formation water. When a source of water has been developed it is generally found necessary to resort to various treatments in order to prevent zonal damage or plugging of the injection wells. Such treatment may by means of either an "open" or "closed" system. For an open system no effort is made to prevent air from contacting the water. Accordingly, several or all of the following treatments may be involved: (1) oil separation, (2) iron removal, (3) suspended solids removal, (4) algae and bacteria control, (5) corrosion control, and (6) stabilization of the water. Equipment required consists of flocculators, settling basin and filters. The latter may operate either under gravity flow or under applied pressure. All filters require periodic back-washing but far less so for the pressure than for the gravity flow type. For a closed system no treatment other than filtration is generally necessary as no air comes in contact with the injection water.

Corrosion of equipment presents a serious problem, especially when brines are being handled. While inhibitors are helpful to mitigate corrosion, transite pipe and wooden tanks can be used to advantage in many instances. Wherever dissimilar metals touch, proper insulation should be provided to prevent galvanic corrosion. To minimize pump corrosion, stainless and monel metal are used extensively, and one manufacturer has a pump using porcelain plungers.

Well injection can be accomplished either with a central pumping plant or by placing pumps at individual locations, and either method offers certain disadvantages. The central plant requires a capital outlay for added pipe, while operating costs will be higher when pumps are placed at scattered locations. As for subsurface conditions, gun perforated wells will take less water than shop perforated ones, but this disadvantage may be offset by the higher degree of zonal selectivity it is possible to obtain. Water is generally injected through cement-lined tubing landed on a packer, but in areas where corrosion is not severe, annulus injection may be resorted to.

Continued on Page 7, Section 2

MID-CONTINENT SECTION

Hydrafrac in Oklahoma

By J. C. McCarthy

The first regular fall meeting of the Mid-Continent Section was held November 13, in the Red Lacquer Room of the Alvin Hotel in Tulsa, Okla. Approximately 125 people were in attendance during the technical program to hear W. E. Hassebrock, development engineer with the Halliburton Oil Well Cementing Co., Duncan, Okla., discuss application and results of Hydrafrac, with particular emphasis on Oklahoma. Hassebroek has been associated with Halliburton in various capacities since he graduated from Oklahoma A&M College in 1935 with a B.S. degree in chemical engineering. Since the introduction of the Hydrafrac process, he has devoted practically full time to the coordination of laboratory and field work pertaining to that service.

W. E. HASSEBROEK

The process, originally developed by the Stanolind Oil and Gas Co., was placed in commercial operation in March, 1949, and since that time more than 1,900 treatments have been performed extending into practically every section of the United States. A brief discussion of the process theory was given and a number of factors which experience has shown to be important in selecting a well for treatment were listed. Zone isolation for treatment was emphasized with examples given of its importance.

Formations treated and general results obtained in each area were presented. Emphasis was placed on the process applications to Oklahoma where 1,100 treatments in 77 different formations have been performed. Typical

Continued on Page 7, Section 2

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DISCUSSION OF THIS AND ALL FOLLOWING TECHNICAL PAPERS IS INVITED

Discussion in writing (3 copies) may be sent to the Editor, *Journal of Petroleum Technology*, 601 Continental Building, Dallas 1, Texas, and will be considered for publication in the Transactions volume *Petroleum Development and Technology*. Discussion will close December 1, 1950. Any discussion offered thereafter should be in the form of a new paper.

PERFORMANCE OF THE LOWER PAWELEK RESERVOIR, FALLS CITY FIELD, KARNES COUNTY, TEXAS

JOHN W. CRUTCHFIELD, CRUTCHFIELD AND PRUETT, CORPUS CHRISTI, TEX., AND **EMIL F. BOWERS,** SOUTHERN MINERALS CORP., CORPUS CHRISTI, TEX., MEMBERS AIME

ABSTRACT

This paper presents the initial results of a pressure maintenance by water return project in the Lower Pawelek reservoir of the Falls City Field, Karnes County, Southwest Texas. Production is from the Lower Wilcox section at an average depth of 6,030 ft on the downthrown side of a "down to the coast" fault. Of particular interest is that the reservoir oil is high gravity and low viscosity but far undersaturated with gas at the original reservoir pressure and temperature. The early pressure and production history indicated only a partial or limited water drive, and this fact, coupled with the characteristics of the reservoir fluid and artificial lifting problems, made advisable the water injection program to maintain reservoir pressure.

The paper includes a description of the reservoir and reservoir fluids, the pressure and production history, a description of the water injection facilities, and the results of reservoir calculations involving Hurst's unsteady state flow and the material balance equations for calculation of water influx and prediction of the pressure-production relationship at various rates of withdrawal.

The reservoir calculations and initial field results indicate that reservoir pressures in excess of 85 per cent of original pressure can be maintained by control of water injection even at very high rates of production.

INTRODUCTION

The purpose of this paper is to report the initial results of a pressure maintenance by water return program in the Lower Pawelek reservoir, Falls City Field, Karnes County, Texas, and to calculate an empirical relationship between pressure and production in this limited or partial water drive reservoir.

[1]References are given at end of paper.

Manuscript received at office of the Petroleum Branch December 5, 1949. Paper presented at a meeting of the Southwest Texas Section of the Branch in Corpus Christi, Tex., November 16, 1949.

DISCUSSION

Location

The Falls City Field (Fig. 1) is located two miles north of the town of Falls City in Karnes County, Texas, and is approximately 50 miles south-southeast of San Antonio on U. S. Highway 181.

Discovery and Development

The initial block of leases was taken after a surface geological survey identified a major east-west fault and closure on the south or downthrown section. The discovery well, Southern Minerals Corporation's Joe F. Bartosch 1, was completed at 4,650 ft in the Lower Bartosch sand in December, 1944. Drilling was continuous until December, 1946, and resulted in the discovery of 12 oil reservoirs between 4,600 and 6,050 ft in the Middle and Lower Wilcox formations. These are shown on the cross-section (Fig. 2). As of the current date there are 64 oil wells completed as follows:

Reservoir	Southern Minerals Corp.	Gulfshore Oil Co.	Magnolia Petroleum Corp.	Total
Upper Bartosch	0	0	0	0
Lower Bartosch	16	0	0	16
Shulze	7	0	1	8
Upper Faires	2	0	0	2
Lower Faires	4	0	0	4
Upper Moczygemba	0	0	0	0
Lower Moczygemba	2	0	0	2
Olinick	2	0	0	2
Upper Martinez	0	0	0	0
Lower Martinez	5	0	0	5
Upper Pawelek	0	1	0	1
Lower Pawelek	27	1	3	31
Total	65	2	4	71

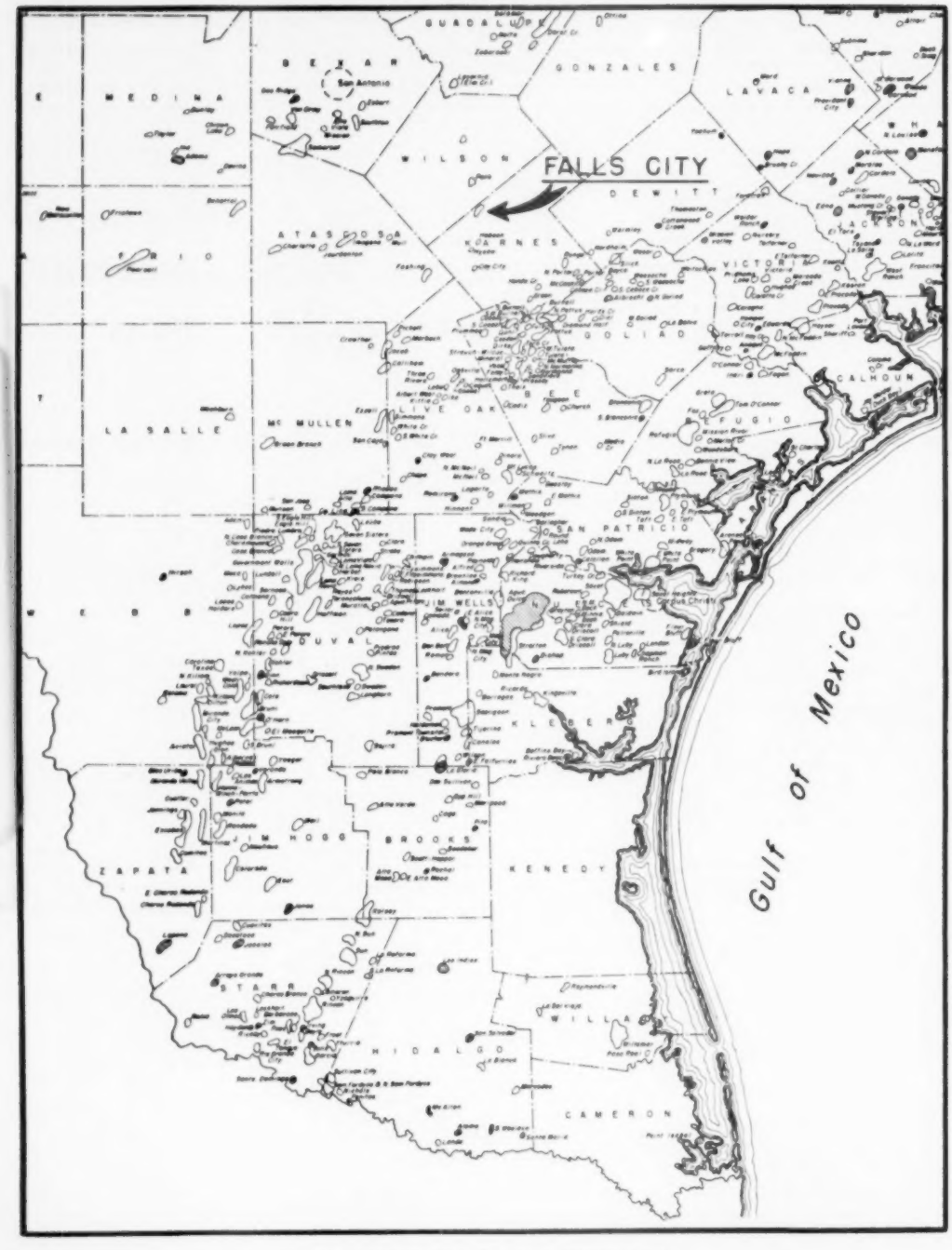

FIG. 1 — OIL AND GAS FIELDS OF SOUTHWEST TEXAS

A deep test well was drilled in 1949 to 10,235 ft which penetrated the Edwards formation and a portion of the Glenrose formation. No commercial oil or gas production was indicated below the Lower Wilcox.

LOWER PAWELEK RESERVOIR

Geological Data

The Lower Pawelek reservoir is an elliptical, low relief structure with sand thicknesses ranging from 25 to 40 ft. The producing formation (Fig. 3) has been encountered as high as 5,663 ft subsea, and original water table has been established by drill stem tests at 5,716 ft subsea, indicating a maximum oil column of 53 ft. No gas cap has been encountered.

The average net effective oil sand thickness (Fig. 4) is 16 ft and the producing area includes 919 acres. The producing formation can be described as medium grained, gray, calcareous sand sometimes being interbedded with shale. Analyses of 47 core samples from two wells indicate an average porosity of 24.5 per cent and average permeabilities parallel and perpendicular to the bedding plane of 311 and 121 md, respectively. Connate water saturations by restored state or capillary tests were measured in three cores, and are calculated to average 37 per cent of pore space corresponding to the average permeability and to the average height of sand above water. A summary of reservoir data is presented in Table I.

Engineering Data

Because of the multiplicity of producing sands and the desire to complete some wells in each of the productive reservoirs, it was not possible to uniformly pattern the producing wells over the Lower Pawelek reservoir. The average well density is 34 acres per well; however, the minimum distance between offsetting wells is 660 ft.

Completion practice was to core into the Lower Pawelek sand, bottom the hole approximately five ft above the water level, set 5½-in. casing to bottom, and gun perforate the lower five to ten ft of sand. An effort was made to select completion intervals between impermeable barriers and breaks. The latter one-half of the wells were completed with multi-stage cementing devices set at approximately 5,600 ft for added protection against migration of reservoir fluids in upper sands.

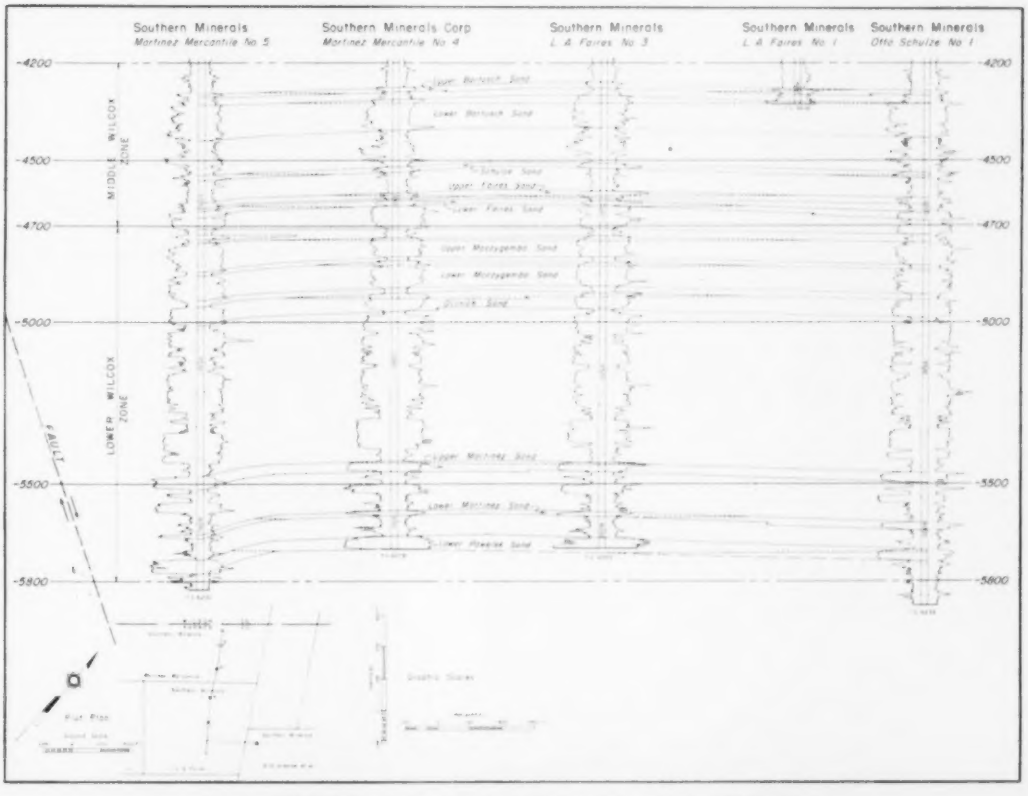

FIG. 2 — NORTH-SOUTH CROSS SECTION, FALLS CITY FIELD, KARNES COUNTY, TEXAS.

The first Lower Pawelek reservoir pressure measured was 2,583 psi in Bartosch 1-A in November, 1945, at which time the cumulative production was 23,133 bbl of oil. Pressures as high as 2,611 psi (Olinick 6, March, 1946) have been measured, and the original reservoir pressure has been assumed to be 2,625 psi. The subsurface pressure datum plane is 5,685 ft subsea, midway between the crest of the structure and the original water level.

A subsurface sample of Lower Pawelek reservoir oil and gas was taken in November, 1945. Flash liberation, differential liberation, and viscosity data are shown in Figs. 5, 6, and 7. Briefly, the sample showed a saturation pressure of 797 psi at the reservoir temperature of 190°F. The stock tank gas-oil ratio at zero lb separator pressure was 167 cu ft per bbl with an API gravity of 39.2 degrees and a shrinkage factor of 0.847. The oil viscosity was 1.03 centipoises at original reservoir conditions, and 1.64 centipoises at atmospheric pressure and reservoir temperature.

An analysis of bottom water from the reservoir indicated a salinity of 18,691 ppm chloride. It is of interest to note that five of the upper reservoirs in the Falls City Field are underlain with water having chloride contents of less than 5,000 ppm.

Table I — Reservoir Data

Falls City Field — Lower Pawelek Sand

Original Oil-Water Contact, Ft SS	5,716
Average Porosity, Per Cent	24.5
Permeability, Millidarcys*	
Parallel to Bedding Plane	311
Perpendicular to Bedding Plane	121
Connate Water, Per Cent of Pore Space	37
Average Net Pay Section, Ft	16.1
Productive Area, Acres	919
Estimated Oil in Place, MM Reservoir Bbl	17.70
Original Reservoir Pressure, psig at 5,685 Ft SS	2,625
Reservoir Temperature, F	190
Characteristics of Produced Oil**	
Dissolved Gas-Oil Ratio	167
Shrinkage Factor, Bbl Stock-Tank Oil Per Reservoir Bbl	0.847
Oil Gravity, API	39.2
Sodium Chloride Content of Connate Water, PPM	18,690
Viscosity of Original Reservoir Oil Centipoises	1.03

*Average of approximately 47 determinations on cores from two wells.
**Original reservoir oil produced under separator conditions of 0 psi and 70°F.

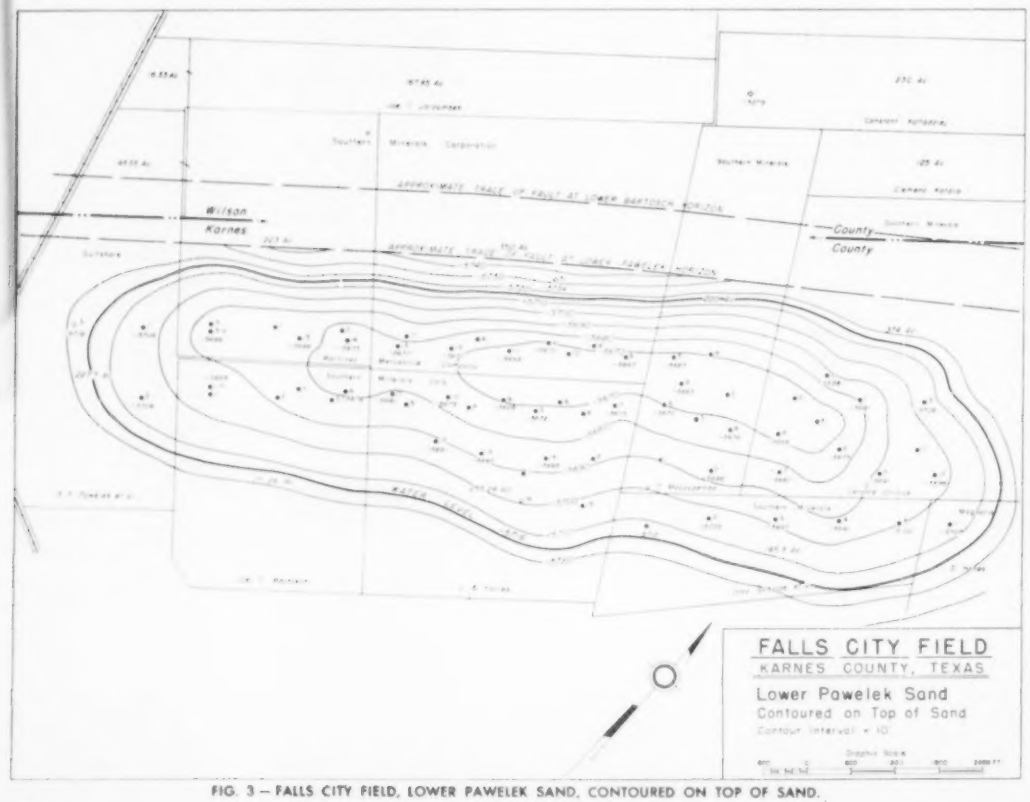

FIG. 3 — FALLS CITY FIELD, LOWER PAWELEK SAND, CONTOURED ON TOP OF SAND.

Pressure-Production History

A total of eight shut-in subsurface pressure surveys (Fig. 8) had been made in key wells up to March 1, 1948, with a maximum of six months between any two surveys. Reservoir pressures have been determined by area-weighting the entire reservoir. Cumulative production on that date was 694,281 bbl. Many of the structurally low wells produced water which averaged 20 per cent of total fluid during the latter part of 1947. Following development, oil production ranged from approximately 1,000 to 1,250 B/D.

As late as March, 1947, it was believed that the reservoir pressure would stabilize at a high level although no reservoir calculations had been made by that date. It appeared that the water influx was approaching reservoir withdrawals in magnitude since any large difference would result in a major pressure decline because of the extremely low compressibility of the undersaturated reservoir oil. It soon became apparent, however, that the aquifer was limited in extent and that the drive would not support the desired rate of oil production with increasing volumes of saltwater at reservoir pressures which would sustain natural flow.

By March 1, 1948, the reservoir pressure had declined to 2,281 psi, or 344 lb less than the original pressure. Five wells had been placed on artificial lift and a majority of the remaining wells had declined in tubing pressure to the critical point required to maintain natural flow.

It should be pointed out that this field is located in an area almost devoid of natural gas reserves which might be utilized for gas lift. Installation of convential pumping or hydraulic pumping equipment appeared inadvisable because of limited fluid capacity available for depletion of water drive reservoirs and also because of the high initial investment required. Limited quantities of natural gas were obtained by laying eight miles of transmission line and installing compressor facilities to pick up casinghead gas.

A second production problem became apparent during this period when surface evaporation was no longer adequate for disposing of the increasing volumes of salt-water. These two problems strongly indicated the desirability of a pressure maintenance program by returning produced water to the Lower Pawelek reservoir.

Prediction of Pressure-Production Relationship

To fully evaluate the effect of water injection on reservoir pressure, a series of reservoir calculations was made involving the volumetric balance equation[1] and Hurst's[2] unsteady state

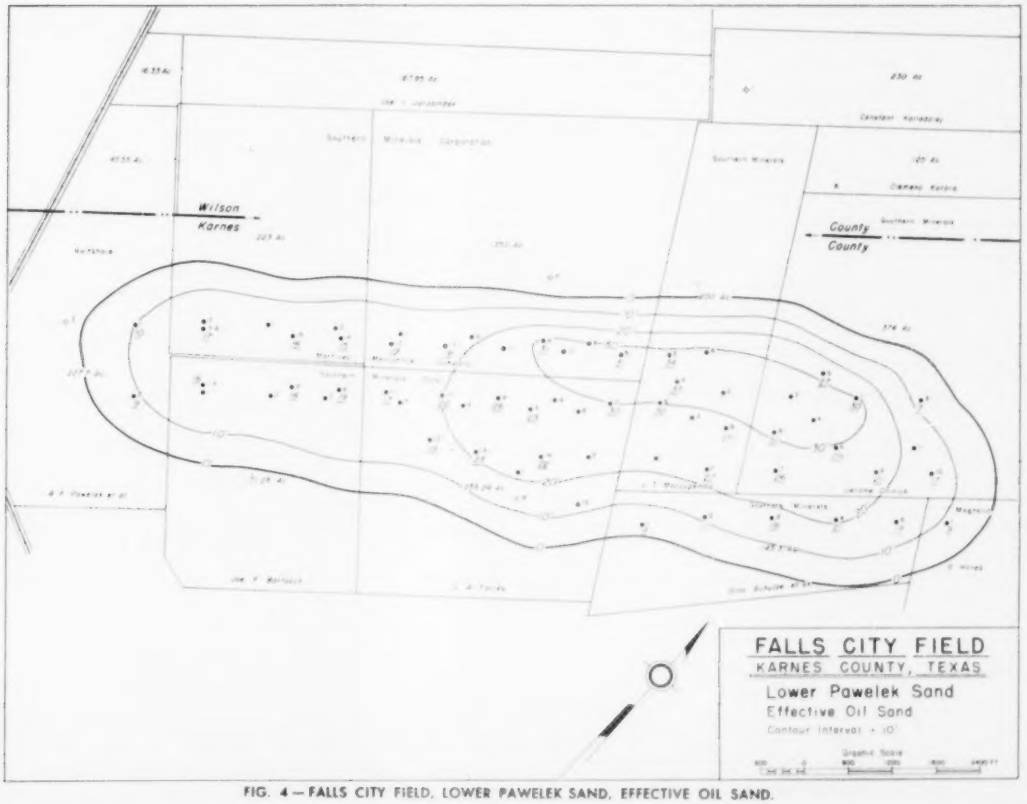

FIG. 4 — FALLS CITY FIELD, LOWER PAWELEK SAND, EFFECTIVE OIL SAND.

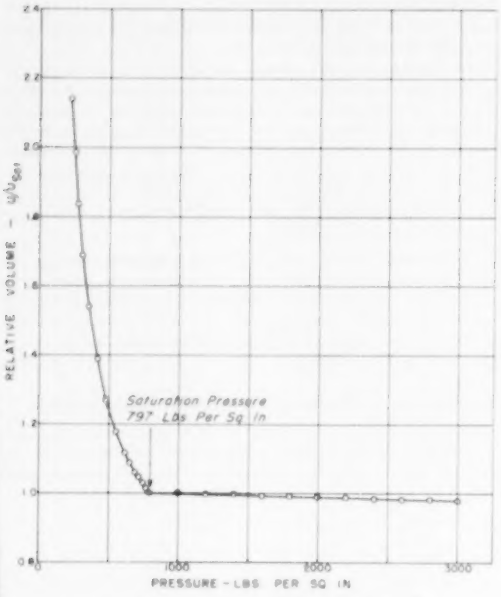

FIG. 5 — PRESSURE-VOLUME RELATIONS AT 190°F.

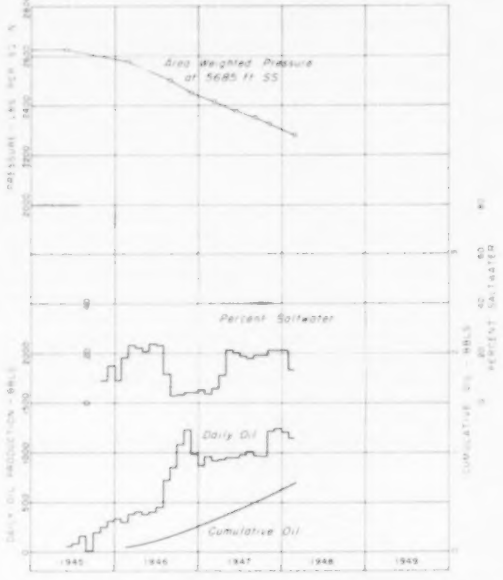

FIG. 8 — PRESSURE AND PRODUCTION DATA, LOWER PAWELEK SAND.

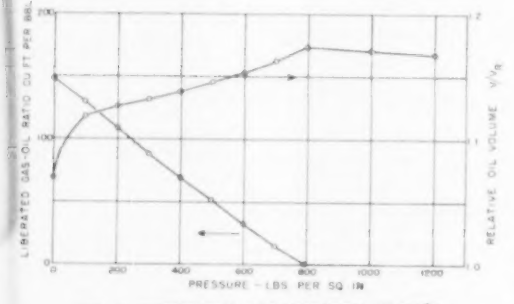

FIG. 6 — DIFFERENTIAL GAS LIBERATION AT 190°F.

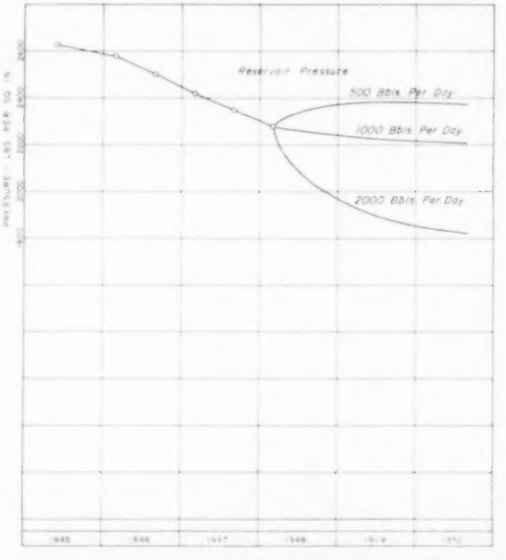

FIG. 9 — CALCULATED RESERVOIR PRESSURES AT VARIOUS RATES OF WITHDRAWAL.

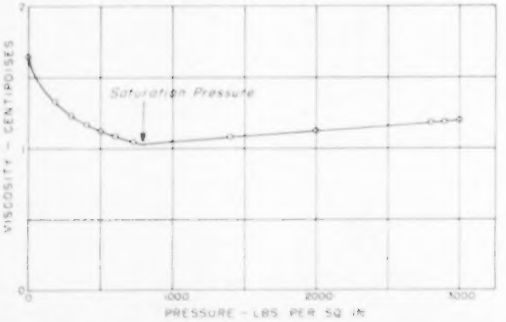

FIG. 7 — VISCOSITY OF RESERVOIR OIL AT 190°F.

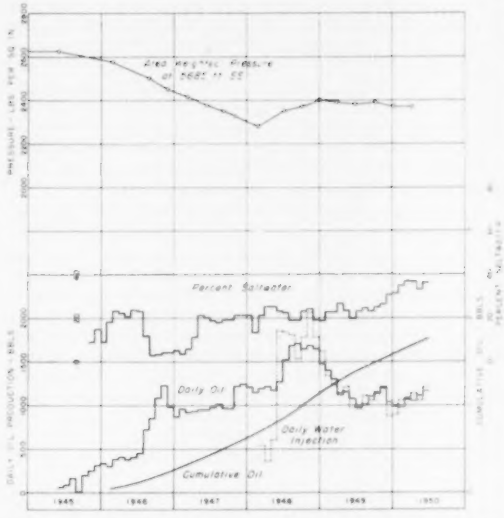

FIG. 10 — PRESSURE AND PRODUCTION DATA, LOWER PAWELEK SAND.

flow equation for calculating water influx and predicting reservoir pressures at various rates of oil and water production and water injection. The equations, adapted to the Lower Pawelek reservoir, are as follows:

$$Z = [\Delta n\ \mu + z] - z' - [n(\mu - \mu_o)]$$

Total Water Influx	Oil and Water Withdrawals	Water Injection	Expansion of Oil Remaining

where

Z = Total water influx, bbl

Δn = Cumulative oil produced, stock tank bbl

n = Original oil in place, stock tank bbl

μ_o = Bbl of oil under original reservoir conditions which yield on bbl of stock tank oil

μ = Bbl of oil, and gas released from solution, at pressure P resulting from μ_o bbl of original reservoir oil

z = Cumulative water production, bbl

z' = Cumulative water injection, bbl

Z = Cumulative total water influx, bbl

and Hurst's formula for radial water influx,

$$Z = \frac{.1615KH\phi cR^2}{\mu} \sum_{i=0}^{i=n-1} (P_i - P_{i+1})\, f\left[(\theta_n - \theta_i)\ \frac{K}{\mu\phi c}\ \frac{1}{R^2}\right]$$

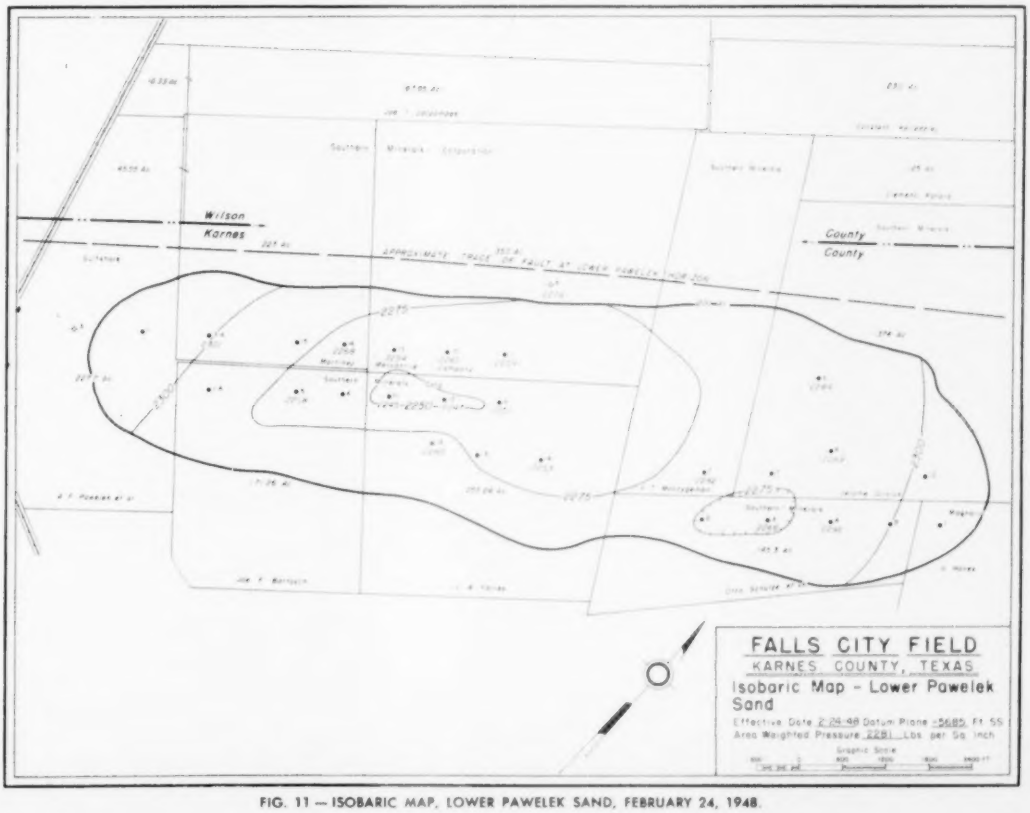

FIG. 11 — ISOBARIC MAP, LOWER PAWELEK SAND, FEBRUARY 24, 1948.

where

P = Reservoir pressure, lb psi
K = Permeability, cu ft/day/sq ft/lb/sq ft/ft
μ = Water viscosity, centipoises
c = Apparent compressibility, cu ft/cu ft/lb/sq ft
ϕ = Porosity, fractional
$\alpha^2 = \frac{K}{\mu \phi c}$, diffusivity
R = Effective radius of reservoir, ft
H = Thickness of producing formation, ft
σ = Fraction of perimeter through which water can enter
θ = Time, days
Z = Cumulative water influx, bbl

The above equation can be simplified by letting

$$\bar{K} = f\left[(\theta_n - \theta_1) \frac{\alpha^2}{R^2} \right]$$

and the final equation becomes

$$Z = 161 \phi c H \sigma R^2 \int_{\bar{K}\theta_n}^{K\theta_n} (P_n - P) d\bar{K}$$

The procedure used in the calculations was to solve the volumetric balance at each of the survey dates over the life of the field to determine the total water influx. These data were then substituted in the unsteady state equation and various values were assumed for α^2/R^2 until a more or less constant value was found for the term $161 \phi c H \sigma R^2$ involving the physical constants of the reservoir. An assumed value of α^2/R^2 equal to .01 gave the best series of values for the physical constant which varied a maximum of four per cent from the arithmetic average over six pressure surveys.

With the above assigned values, the unsteady state equation and volumetric balance were solved simultaneously for the prediction of reservoir pressures at various rates of oil and water withdrawals and water injection. The results of these calculations are shown in Fig. 9. By this method it was calculated that a reservoir pressure of approximately 2,400 psi could be maintained at a fluid production rate of 2,000 B/D with the injection of 1,500 B/D of water. In a similar manner it was calculated that the reservoir pressure would have declined to 2,077 psi by January 1, 1949, in the absence of pressure maintenance.

Water Injection Facilities

A closed, gravity type, saltwater gathering system having a total capacity of 7,800 B/D was installed to collect the water

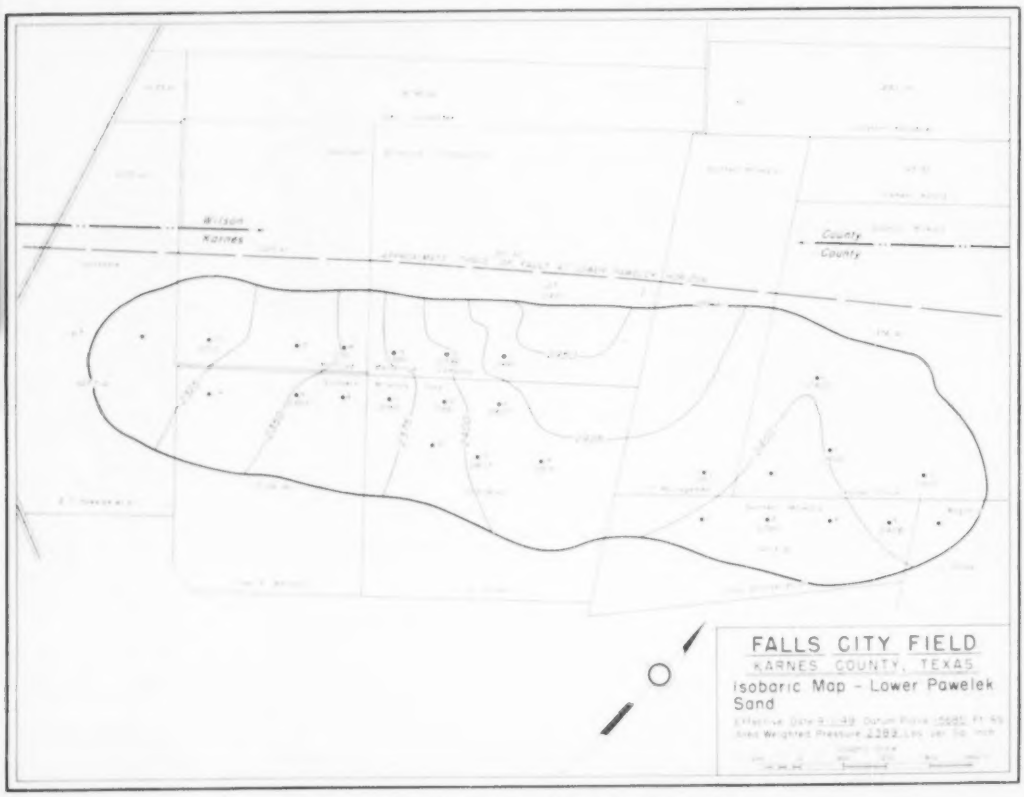

FIG. 12 — ISOBARIC MAP, LOWER PAWELEK SAND, APRIL 1, 1949.

at a central point for settling and pumping into the injection well. The system consists of 8,600 ft of 4½-in. O.D. fibre and steel lines with steel pipe installed at road and creek crossings. Water from the gathering system is discharged into a 500-bbl settling tank where the water surface is covered with a 12-in. blanket of crude oil to prevent exposure to air and light. A reciprocating pump, rated at 4,800 B/D at 250 psi pressure and equipped with a torsion-tube liquid level speed control, picks up the water after it has been measured through a recording orifice meter. The water is then delivered through a high pressure steel line to the injection well.

The water injection well (Martinez 5) was completed by washing down a previously abandoned dry hole located midway the long axis of the reservoir and between the water level and the major fault. Top of the Lower Pawelek sand in the well is 18 ft below the original water table. Location of the well is particularly advantageous since it is located in the area most remote from the natural water drive. The well was completed with 5½-in. casing with 40 ft of slotted pipe below the cementing assembly which consisted of a solid bottom cement whirler float collar and metal petal basket. The total initial investment for the gathering system and injection well was $21,351 and $17,789, respectively.

Results of Water Injection

The first water was injected on March 3, 1948, at the rate of 500 B/D which was increased to 1,800 B/D in June (Fig. 10). Injection well surface pressures ranged from 400 to 600 lb. The area-weighted pressure measured immediately prior to water injection was 2,281 psi (Fig. 10). On July 1, 1948, after the injection of 100,000 bbl of water, the pressure had increased 64 lb to 2,345 psi. Approximately 213,000 bbl of reservoir fluids had been withdrawn during the same period. As may be noted from the pressure-production curve, the net rate of withdrawals was maintained at approximately 500 reservoir B/D and the pressure increased to 2,400 psi as anticipated by the reservoir calculations. This relative rate of withdrawals and injection has been maintained as closely as possible up to the present time and the last measured pressure was 2,369 lb on April 6, 1950.

Inspection of the isobaric maps (Figs. 11, 12, and 13) gives a graphic picture of the change in the pressure pattern resulting from the injection program.

It may be noted from the pressure-production curve (Fig. 10) that the increase in saltwater production has been moderate since the start of water injection. One well located 1,140

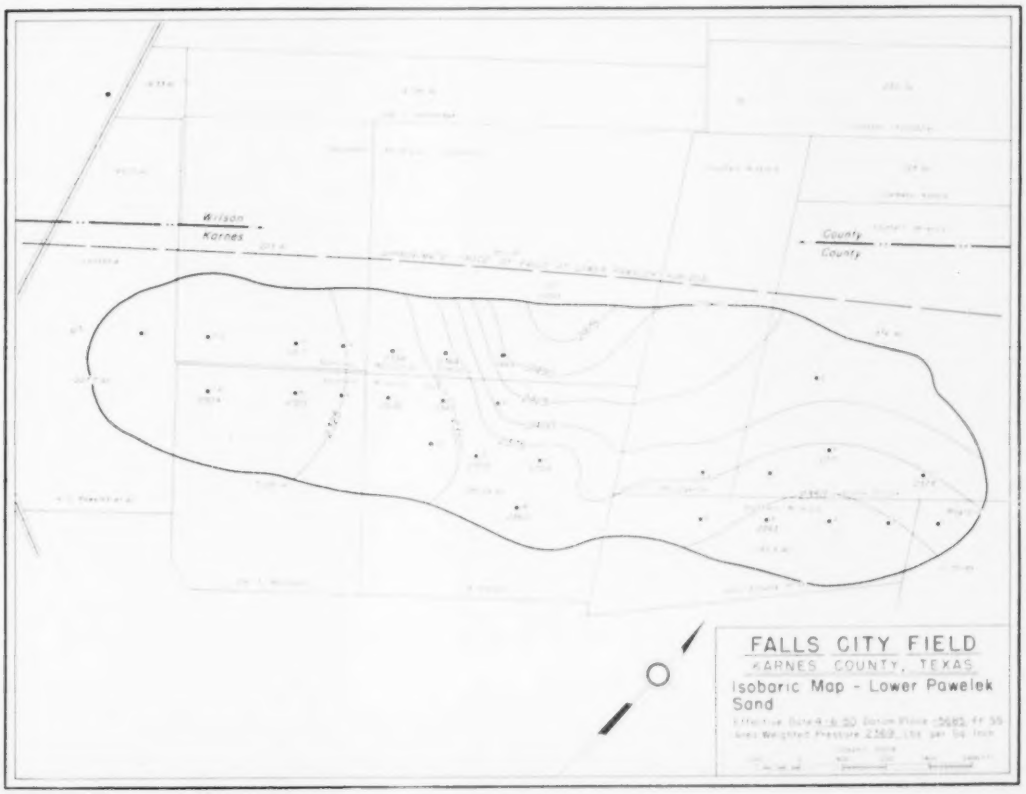

FIG. 13 — ISOBARIC MAP, LOWER PAWELEK SAND, APRIL 6, 1950.

ft from the injection well showed an abrupt increase in water percentage and was recompleted higher in the same sand. No significant changes in water production in other wells have been recorded. The downward trend in flowing tubing pressures has been arrested and in some wells the tubing pressures have been increased as much as 100 psi.

Because of the limited amount of water which can be used in the pressure maintenance program, additional saltwater disposal wells in other sands will be necessary to handle all of the produced water. Also, in the later stages of depletion of the Lower Pawelek reservoir, additional injection wells will be required to provide the necessary injection capacity and to distribute properly the injected water.

ACKNOWLEDGMENT

The writers wish to express their thanks to Maston Nixon, executive vice-president for the Southern Minerals Corporation, for permission to publish this paper, and to others of the company for their assistance in its preparation.

REFERENCES

1. R. J. Schilthuis: Active Oil and Reservoir Energy. *Trans.* AIME (1936), 33.
2. W. Hurst: Water Influx into a Reservoir and Its Application to the Equation of Volumetric Balance. *Trans.* AIME (1942), 57.

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CORRELATION OF BOTTOM HOLE SAMPLE DATA

GUY BORDEN, JR. AND MICHAEL J. RZASA, STANOLIND OIL AND GAS CO., TULSA, OKLA., MEMBERS AIME

ABSTRACT

Laboratory data on bubble point pressures and reservoir volume factors have been correlated as functions of solution gas-oil ratio, calculated gas gravity of the pentanes-and-lighter fraction of the entire fluid, differential residual oil gravity, and reservoir temperatures.

INTRODUCTION

Several correlations of crude oil properties have appeared in the literature.

D. L. Katz[1] in 1942 presented five methods of predicting oil shrinkage, these being of decreasing accuracy for decreasing amounts of information available.

M. B. Standing[2] in 1947 published three correlations of laboratory flash vaporization data of California crudes. From values of GOR (gas-oil ratio), gas gravity, liquid gravity, and temperature, his correlations will predict bubble point pressure, formation volumes of bubble point liquids, and two-phase formation volumes.

Curtis and Brinkley[3] in 1949 presented several correlations. From the gas-oil ratio, an approximation of reservoir volume factor and barrels of condensate recoverable per barrel of reservoir space may be obtained; along with liquid gravity and reservoir temperature, the GOR will allow prediction of bubble point pressure. These last correlations seem to be more qualitative than quantitative.

Generally, laboratory bottom hole sample tests furnish information on solution gas-oil ratios, residual oil gravities, bubble point pressures, viscosities of oils, liquid shrinkages, and occasionally gas gravities. Each of these data has its own applications and use in reservoir engineering calculations. The particular uses of correlated bottom hole sample data are found in

(1) Providing a basis for obtaining estimates of formation crude properties in fields where bottom hole sampling is impractical or impossible.

(2) Greatly reducing the time in obtaining the desired information.

(3) Determining the applicability of the results from various bottom hole samples to particular field problems.

(4) Avoiding, in many cases, the uncertainties of sampling by replacing it with an element over which greater control can be exercised.

(5) Permitting use of preliminary field data in application of production procedures before a bottom hole sample can be obtained and analyzed in the laboratory.

(6) Serving as a check on data which may appear out of line.

(7) Estimating for a particular type crude the appropriate equilibrium constants by working backward from the bubble point pressure.

(8) Estimating original or other past history properties of reservoirs that were not sampled in the past.

PROCEDURE

Application of the published correlations[1,2] to Stanolind laboratory data indicated that the general scheme presented by Standing[2] could give desirable results if changes were made in parameter positions and scales. The correlation curves were drawn with all the variables having consistent gradations except the temperature increments which were drawn in to best fit the data.

The variables from available Stanolind laboratory data are defined below:

(1) Gas-oil Ratio: Gas is liberated at reservoir temperature by differential vaporization (or rather by a series of flashes, approaching differential vaporization) and measured at atmospheric pressure and temperature, at which the compressibility factor is assumed to be unity. The oil is the residual liquid remaining after the pressure has been reduced to atmospheric. For the gas-oil ratio both volumes are corrected to standard conditions of 14.7 psia and 60°F.

(2) Gas Gravity: It was decided to arbitrarily divide the hydrocarbons of the entire bottom hole sample into pentanes-and-lighter and hexanes-and-heavier, and use a calculated gas gravity of the pentanes-and-lighter for a correlating variable. (Sample calculation is shown in Table III.)

(3) Liquid Gravity: This is the API gravity of the residual liquid from the differential vaporization. The gravity is measured at room temperature and corrected to 60°F.

[1]References given at end of paper.

Manuscript received in the office of the Petroleum Branch May 29, 1950. Paper presented at the Mid-Continent Joint Meeting in Tulsa, Okla., May 12-13, 1950.

(4) Temperature: This is the temperature at which the differential vaporization and bubble point pressure determinations are carried out, and is usually the bottom hole (reservoir) temperature.

(5) Bubble Point Pressure: This is the pressure at which there is a break in slope of the pressure-volume curve; that is, the pressure at which gas starts to evolve as pressure is decreased. This bubble point pressure is at the test temperature.

(6) Reservoir Volume Factor: This is the barrels of bubble point oil per barrel of residual oil at 60°F and atmospheric pressure. Separation of gas is by differential vaporization at reservoir temperature.

USE OF CORRELATION CHARTS

Prediction of Bubble Point Pressure and Reservoir Volume Factor

Published data of three samples were used to test the correlations. Table II shows the properties of these crudes and the comparisons of predicted and experimental bubble point pressures and reservoir volume factors.

Example uses of the correlation charts are shown in Figs. 1 and 2.

The method of calculating gas gravity is shown in Table III.

Use of Bubble Point Pressure Correlation Chart to Predict Saturation of Reservoir

Crude "A" was sampled at 3,600 psia and 218°F. The tank oil gravity was 27.4°API. Calculated gravity of pentanes-and-lighter is 0.79.

By entering Fig. 1 at 3,600 psia for bubble point pressure and ending up with gas-oil ratio, while using the above quantities for the variables, a gas-oil ratio of 615 cu ft/bbl is predicted. This means that Crude "A" can hold in solution approximately 615 cu ft/bbl of .79 gravity pentanes-and-lighter gas at 3,600 psia and 218°F and be at its bubble point. Comparing 615 with 525 cu ft/bbl shows that the oil is undersaturated at the sampling conditions. Extrapolating experimental data on Crude "A" shows that 575 cu ft/bbl could be in solution at the sampling conditions. Thus, the undersaturation of the oil is correctly predicted.

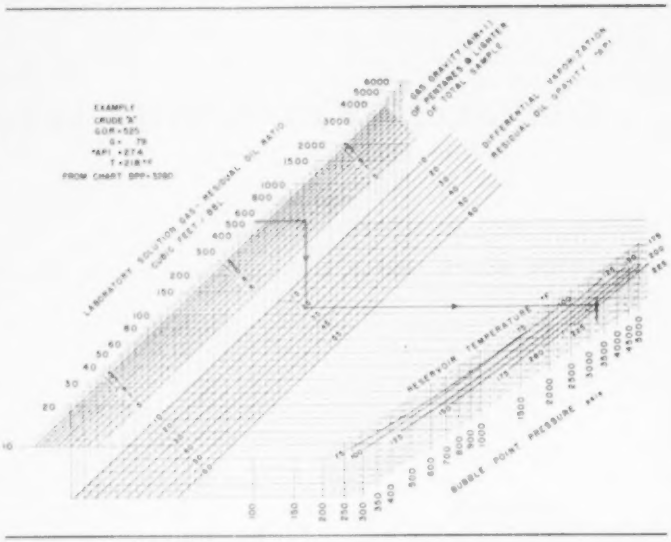

FIG. 1 — BUBBLE POINT PRESSURE CORRELATION.

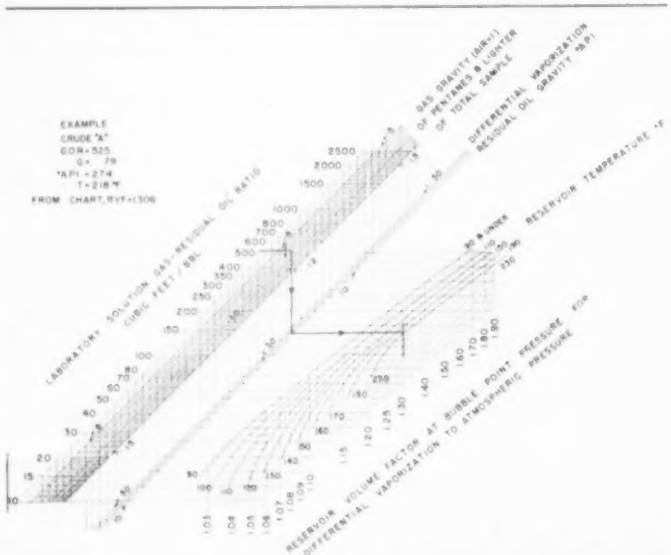
EXAMPLE
CRUDE "A"
GOR=525
G= .79
°API =27.4
T=218°F
FROM CHART, RVF=1.306
LABORATORY SOLUTION GAS-RESIDUAL OIL RATIO CUBIC FEET/BBL
GAS GRAVITY (AIR=1) OF PENTANES & LIGHTER OF TOTAL SAMPLE
DIFFERENTIAL VAPORIZATION RESIDUAL OIL GRAVITY °API
RESERVOIR TEMPERATURE °F
RESERVOIR VOLUME FACTOR AT BUBBLE POINT PRESSURE AND DIFFERENTIAL VAPORIZATION TO ATMOSPHERIC PRESSURE

FIG. 2 — RESERVOIR VOLUME FACTOR CORRELATION.

Table I — Range of Data on Bottom Hole Samples from Which Correlations Were Made

	Company Operating Divisions							
	Division 1		Division 2		Division 3		Division 4	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Bubble Point Pressure psia	1187	4650	246	3625	514	3551	292	1239
Reservoir Vol. Factor, bbl/bbl*	1.082	1.745	1.054	1.610	1.098	1.678	1.037	1.217
Gas-Oil Ratio, cu ft/bbl*	156	1165	94	1383	151	1246	50	318
Oil Gravity, °API*	23.8	49.6	29.1	42.6	22.7	49.9	24.8	31.5
Calculated Gas Grav. (Air = 1)	.56	1.21	.92	1.66	.837	1.30	1.09	1.36
Reservoir Temp., °F**	126	236	82	159	101	236	122	156

*From laboratory differential vaporization.
**Division 2 data dominated the temperature range up to 105°F; Division 3, the range 105° to 125° F; Division 4, the range 125° to 145°F; and Division 1, the range from 145°F. up.

Table II — Properties of the Crudes

Component	Analysis, Mol Fractions Crude "A"	Crude "B"	Crude "W"
Methane	.4404	.5345	.4573
Ethane	.0432	.0636	.1032
Propane	.0405	.0466	.0665
Butanes	.0284	.0379	.0417
Pentanes	.0174	.0274	.0297
Hexanes	.0290	.0341	
Heavier	.4011	.2559	.3016

	Crude "A"	Crude "B"	Crude "W"		
			Flash Data	Differential Data	Field Data
Reservoir Temperature, °F	218	243	145	145	145
Lab. Flash GOR, cu ft/bbl*	525	1078	959		921
Differential Vaporization GOR				1065	
Residual Oil Gravity, °API	27.4	34.5	42.0	40.3	42.4
Calculated Gas Gravity of C_5	.790	.812	.886	.886	.797
Experimental Bubble Pt Pr, psia	3305	4470	2952	2952	2952
Correlated Bubble Pt Pr, psia (Fig. 1)	3260	4620	2640	2960	2730
Experimental Res Vol Fac, bbl/bbl	1.305	1.64	1.477	1.550	1.477
Correlated Res Vol Fac (Fig. 2)	1.306	1.700	1.490	1.541	1.450
Differences: BPP psi	45	−150	−312	−8	−222
RVF bbl/bbl	.001	−.060	−.013	.009	.027
Per Cent Difference: BPP	1.4	3.2	11.8	.3	8.1
RVF	.1	3.7	.9	.6	1.9

*Standard conditions for volumes are 14.7 psia, 60°F

Table III — Calculation for Gas Gravity of Pentanes-and-Lighter (Crude "A")

Component	Mol Fraction	Molecular Weight	Mol Fr x M W
Methane	.4404	16.04	7.064
Ethane	.0432	30.07	1.299
Propane	.0405	44.09	1.786
Butanes	.0284	58.12	1.651
Pentanes	.0174	72.15	1.255
SUMS	.5699		13.055

$$\text{Molecular weight } C_5 = \frac{13.055}{.5699} = 22.91$$

$$\text{Molecular weight of air} = 29$$

$$\text{Gas Gravity } C_5 = \frac{22.91}{29} = .790$$

DISCUSSION

Accurate predictions of reservoir fluid properties are of great importance in reservoir engineering studies. It was for this purpose that this investigation was begun and correlations determined. Published correlations[5,6] aided the course of action and suggested the forms of the correlations.

Laboratory data for correlation purposes were obtained from bottom hole sample reports filed at the Stanolind Oil and Gas Co. Research Laboratory. These data are from samples from the company's wells extending from the Gulf Coast to the Rocky Mountains. Standing used California oils and gases for his correlations[4] which may account for the differences in the correlations.

Table IV shows the precision of the correlations with the data from which they were made.

The samples of Table II were chosen to show the use of the correlations because their data have been published.[1,2] The correlations were made from differential vaporization data only. It is realized, however, that the usefulness of this type of correlation would be greatly increased if crude properties and conditions as determined from flash vaporization and field data might also be correlated by the same charts. Flash vaporization data of Crudes "A" and "B" are fairly well correlated by Figs. 1 and 2. The flash and field data of Crude "W" are not as well fitted to the correlations as are the differential vaporization data.

Normally, flash vaporization will show greater gas release than differential if both are conducted at the same temperature. The reason for the lower gas-oil ratio in Crude "W," Table II, is because the flash was conducted in two stages and the second stage temperature was 60°F. which allowed less gas evolution than the higher temperature. These differences in the types of vaporization and the temperatures will necessitate judgment in the use of flash data with the presented correlations.

The use of these correlations with field data may be hazardous, inasmuch as laboratory data were used to develop the charts. However, a rough estimate of bubble point pressure and relative volume factor using field data with these correlations may be of some usefulness.

It was found that the geographical location of the Stanolind wells sampled made little difference in the prediction of bubble point pressures and reservoir

volume factors. Recombination samples were not well predicted by the correlation for bubble point pressure. Four samples at lower temperatures (95°F to 127°F) had bubble point pressures predicted from 12 per cent to 53 per cent low; two at higher temperatures (208°F and 230°F), 10.8 per cent and 18.37 per cent high.

Differences in reservoir volume factors for samples at bubble point pressures and at pressures higher than the bubble point are due to the liquid compressibility. Compressibilities range from 5×10^{-6} to 18×10^{-6} bbl/bbl/psi for Stanolind samples with most falling in the 7×10^{-6} to 11×10^{-6} bbl/bbl/psi limits. Therefore, the reservoir volume factor will decrease by approximately 0.001 for every hundred psi above the bubble point pressure.

CONCLUSIONS

Figs. 1 and 2 will permit estimation of bubble point pressures and reservoir volume factors from laboratory solution gas-oil ratios, calculated specific gravities of the pentanes-and-lighter fraction of the entire fluid, residual oil gravities, and reservoir temperatures. It should be possible, in many instances, to determine if a reservoir is saturated or undersaturated.

ACKNOWLEDGMENT

The authors wish to express their appreciation to the management of the Stanolind Oil and Gas Co. for permission to present and publish this paper.

Table IV — Precision of Correlated Data

Bubble Point Correlation, Fig. 1		
Total Points from Bottom Hole Sample Data		188
Total Points from Recombination Sample Data		6
Average Per Cent Prediction High		8.16%
Average Per Cent Prediction Low		10.50%
Average Per Cent Prediction Total		1.84% Low
Per Cent of Data Points Within 10% of Predicted BPP		65.5%
Per Cent of Data Points Within 15% of Predicted BPP		84.5%
Maximum % Deviation (True Value 1437, Predicted 863)		66.5%
Maximum psia Deviation (True Value 3760, Predicted 4600)		840 psia
Division	Total Samples	Within 15% Predicted
Division 1	77	72
Division 2	81	61
Division 3	19	15
Division 4	17	16
No. of Samples with Predicted BPP More than 200 psi High		23
No. of Samples with Predicted BPP More than 200 psi Low		30
Reservoir Volume Factor Correlation, Fig. 2		
Total Points from Bottom Hole Sample Data		172
Total Points from Recombination Sample Data		6
Average Total Deviation		1.0%
Per Cent of Points within 2.6% of Predicted Value		95.5%
Average Deviation High (bbl/bbl)		.015
Average Deviation Low (bbl/bbl)		.014
Maximum % Deviation (True Value 1.445, Predicted 1.605)		10%
Maximum Deviation bbl/bbl (True Value 1.445, Predicted 1.605)		.160

REFERENCES

1. A. B. Cook, E. J. Dewees and H. M. Harris: "Bureau of Mines Analysis of Subsurface Oil Samples," *Petroleum Engineer*, (May, 1945) 85.
2. R. C. Curtis and T. W. Brinkley: "Calculation of Natural Condensate Recovery," Presented API Div. of Prod., Tulsa, Okla., March 23-25, **1949**.
3. C. R. Dodson and M. B. Standing: "Prediction of Volumetric and Phase Behavior of Naturally Occurring Hydrocarbon Systems," *API Drill. and Prod. Prac.*, (1941) 326-340.
4. D. L. Katz: "Prediction of Shrinkage of Crude Oils," *API Drill. and Prod. Prac.*, (1942) 137-147.
5. B. H. Sage and H. Reamer: *Trans.* AIME, (1941) **170**, 179.
6. M. B. Standing: "A Pressure-Volume-Temperature Correlation for Mixtures of California Oil and Gases," *API Drill. and Prod. Prac.*, (1947) 275-287.

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THE EFFECT OF PERMEABILITY STRATIFICATION IN COMPLETE WATER-DRIVE SYSTEMS

MORRIS MUSKAT, GULF OIL CORP., PITTSBURGH, PA., MEMBER AIME

ABSTRACT

A theory is presented for calculating the performance history of complete water-drive systems producing from idealized stratified formations. The general equations are applied to systems where the permeability stratification is either of the exponential or linear type. Calculations were carried through for different degrees of permeability stratification, but with special emphasis on the effect of the mobility ratio between the produced oil and the invading water on the resultant performance. These results are also expressed graphically as curves for the initial water breakthrough recovery, for the different degrees of stratification, as a function of the mobility ratio, and of the composition of the produced fluid stream as a function of the cumulative oil recovery. For several typical cases the latter has also been plotted as a function of the cumulative oil and water throughflow. The general result is that when the mobility of the oil is lower than that of the invading water the channelling tendency resulting from the permeability stratification becomes aggravated as the higher permeability zones become flooded out. Situations of this type would obtain when producing low gravity or highly viscous oils. Conversely, if the mobility of the oil is high compared to that of the invading water, the flooding of the high permeability zones will lead to a retarding and choking effect, and the gross bypassing phenomena will be partially suppressed. These conditions would correspond to those of flooding high gravity or low viscosity oils. A discussion is given of the various basic assumptions made in the analysis, including that of ignoring the stripping phase of the production history as implied by relative permeability concepts.

INTRODUCTION

The physical ultimate recoveries from oil reservoirs are basically determined and limited by the physical oil displacement processes associated with the reservoir producing mechanism. In practice, however, the economic ultimate recoveries are further limited by the mobility of the reservoir fluids and the uniformity and continuity of the producing formation. In fact, it is the differential depletion between the component parts of the composite reservoir which ultimately determines the total recovery at the time of field abandonment. While this observation applies to both the solution gas drive and gravity drainage mechanisms, in which use is made only of the energy contained within the original oil-bearing reservoir, it is of even more paramount importance under operations wherein the energy associated with extraneous fluids provides the ultimate oil expulsion mechanism. Whether the invading fluid is the water from an edgewater drive, water injected for pressure maintenance, gas injected for pressure maintenance, or gas returned to the formation in a cycling program, it is often the continuity and uniformity of the producing section which will control the economic efficiency of the operations.

The importance of the problem of reservoir non-uniformity does not, of course, lessen its complexity or the difficulties of its solution. In fact, these are inherently such that the concept of a "general" solution is virtually meaningless. About all that can be reasonably hoped for is the analysis of specific and well-defined types of non-uniformity which may give some degree of approximation to actual reservoir conditions. Since variations in the nature of the reservoir which depend only on the position along the streamlines will not lead directly to major differential depletion development within the reservoir, the types of non-uniformity considered thus far have involved stratification assumptions. That is, the producing section has been replaced by a multi-layer "sandwich," each uniform areally, and differing from the others only in its basic physical constants as to thickness, porosity and permeability. The fluid motion in the composite system is thus approximated by a parallel superposition of the independent fluid movements in the individual strata.

For the specific application to cycling operations the theory of the effect of permeability stratification has been developed for both discontinuous[1] and continuous types of permeability stratification. Among the latter, treatments have been given of systems in which permeability distributions are governed by exponential, linear[2] or probability[3] functions. In all these studies complete dynamical equivalence was assumed between the injected dry gas and the displaced wet gas. The overall effective permeability of each stratum was therefore considered as constant and independent of the degree of invasion of the injected fluid.

In the case of the displacement of oil by water, the assumption of dynamical equivalence between the water and oil will be strictly valid only by accident. Even if the oil viscosity should be the same as that of the water, the effective permeability to the oil in the presence of the connate water will in general be quite different from that of the water behind the water-oil interface flowing past the trapped residual oil. As a result the effective permeability for the stratum as a whole and rate of water invasion will change with time as the intrusion continues. The differential fluid motion in the individual strata will thus also vary with time. Qualitatively, it is easy to predict the resultant effects. If the permeability to viscosity ratio of the invading fluid exceeds that of the fluid displaced, the stratification and bypassing effect of the perme-

[1]References given at end of paper.

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ability variation itself will be accentuated. Conversely, if the permeability to viscosity ratio of the invading fluid is less than that of the fluid displaced, the rate of fluid advance in the more permeable strata will become increasingly retarded as the invasion continues, and the channelling tendency will be reduced. It is the quantitative aspects of these phenomena which require detailed analytical treatment and will be the subject of the following sections.

GENERAL THEORY

A little consideration will show that even for a single uniform stratum the history of the fluid motion when the invading and displaced fluids are not dynamically identical will be extremely difficult to determine. In fact, thus far only the cases of simplest geometry, namely linear, radial and spherical, have been quantitatively treated.[3] General well pattern effects are necessarily ignored in such simplified approximations, and the produced fluid is assumed to change suddenly and completely to the invading fluid when the latter first reaches the producing wells. The effect of incomplete pattern sweep efficiency has been taken into account in the study of cycling operations in formations with exponential permeability distributions.[4] It can also be formally included in a general theory of the composition history of the production from stratified formations even when the invading and displaced fluids are not assumed to be dynamically equivalent. From a practical standpoint, however, the resulting analysis is virtually intractable.

The only theoretical treatment thus far reported on the recovery of oil by invading water in undepleted stratified formations without ignoring the differences in mobility between the oil and water is that of Dykstra and Parsons.[5] A discrete layer analysis was used in this study, and a probability permeability distribution was simulated by proper choices of the individual permeabilities of a 50-layer subdivision of the composite section. In this paper will be given the general formulation of the problem for continuous permeability distributions, and this will be applied specifically to the exponential and linear distributions.

If it is assumed that the permeability-saturation characteristics of all the strata in the composite section are the same and that the residual oil saturations behind the water-oil interfaces are the same, as well as the oil saturations in the uninvaded areas,* the rate of water invasion or oil production, in reservoir volume, for any unit thickness lamina at depth z, of homogeneous permeability k, will be expressible as:

$$Q(t, z) = k\ F(kt) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)^{**}$$

where the function $F(kt)$ expresses the effect of the displacing fluid invasion on the overall resultant permeability, and the factor k accounts for the absolute permeability of the lamina. The cumulative throughflow to the time t will then be:

$$\bar{Q}(t, z) = k \int_0^t F(kt)\ dt \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Initial water breakthrough will develop when the total throughflow equals the volume of clean recoverable oil in the lamina, i.e., when:

$$\bar{Q}(t, z) = ASf = k \int_0^t F(kt)\ dt \quad . \quad . \quad . \quad . \quad . \quad (3)$$

where A is the initial oil productive area, S the areal sweep efficiency, and $\bar{f}$ the net displacement porosity, i.e., the product of the porosity and the increase in local water saturation in the water invaded area or decrease in oil saturation. Since by Equation (3), ASf is evidently a function only of kt, it may be formally inverted so as to give:

$$t(breakthrough) = \frac{\Psi(ASf)}{k} \quad . \quad . \quad . \quad . \quad . \quad (4)$$

where Ψ is the inverse of the integral of Equation (3). Equation (4) shows that the breakthrough times will in general be inversely proportional to k, as in the case of cycling operations where the differences between the invading and displaced fluids are neglected.

The cumulative recovery from the whole section of thickness

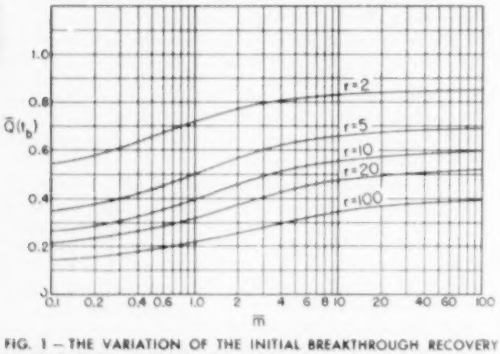

FIG. 1 — THE VARIATION OF THE INITIAL BREAKTHROUGH RECOVERY IN EXPONENTIALLY STRATIFIED SYSTEMS WITH THE MOBILITY RATIO OF THE INVADING AND DISPLACED FLUIDS. $\bar{Q}(t_b)$ = FRACTION OF TOTAL DISPLACEABLE OIL RECOVERED AT THE TIME OF INITIAL BREAKTHROUGH, t_b. m = (MOBILITY OF DISPLACED OIL)/(MOBILITY OF INVADING WATER); r = STRATIFICATION RATIO OF ASSUMED EXPONENTIAL PERMEABILITY DISTRIBUTION.

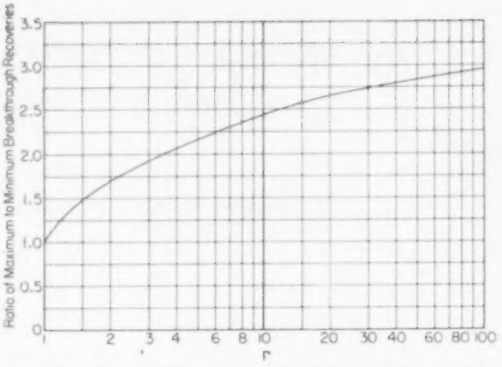

FIG. 2 — THE VARIATION OF THE RATIO OF MAXIMUM TO MINIMUM WATER BREAKTHROUGH RECOVERIES IN EXPONENTIALLY STRATIFIED MEDIA WITH THE STRATIFICATION RATIO, r, FOR THE LIMITS OF INFINITE AND VANISHING MOBILITY RATIOS.

*These assumptions of uniformity, together with that for f below, are made both for reasons of simplicity and the lack of any well established alternative assumptions. Actually, however, the method of analysis given here could also be applied if these parameters were taken as variable with depth or k, although the formal analysis would become considerably more complicated.

**While the product kt is indicated in Equation (1) as the basic element of the argument F to emphasize the role played by a potentially varying permeability, it is the ratio of k to the viscosity which is actually the important dynamical variable.

H, at a time t before breakthrough, will then be, as a fraction of the recoverable oil in the reservoir,

$$\bar{Q}(t) = \int_0^H k\,dz \int_0^t F(kt)\,dt \Big/ A \int_0^H f\,dz \quad . \quad . \quad (5)$$

and that at initial water breakthrough will be:

$$\bar{Q}(t_b) = \int_0^H dz \int_0^{kt_b} F(\tau)\,d\tau \Big/ A \int_0^H \bar{f}\,dz \quad . \quad . \quad (6)$$

where t_b is the breakthrough time in the highest permeability layer, as defined by Equation (4) for $k = k(z = H)$. It is assumed in Equations (5) and (6), and in all the subsequent analyses, that the various permeability strata have been rearranged in increasing sequence from $z = 0$ to $z = H$.

After the first water breakthrough in any individual stratum there will be a gradual rise in water-oil ratio as the initial water cusps expand and ultimately completely envelop the producing wells. The history of this latter phase of the oil production will evidently depend on the well pattern, field geometry, and relative producing rates of the wells. While its effect could be formally introduced into the general theory, there is little point in such a generalization, since the assumed functional form for this phase of the history would necessarily have to be quite specific and arbitrary and would not warrant the additional laborious computations required for its numerical evaluation. Accordingly, it will be assumed hereafter that the production in any layer is converted to 100 per cent water as soon as there is any breakthrough at all.* This is equivalent to setting the pattern sweep efficiency, $S = 1$ in Equation (3), etc.

Proceeding to the period after breakthrough in the most permeable layer, i.e., for $t > t_b$, the fractional oil content in the total fluid production will then be:

$$R_o(t) = \frac{\int_0^{z_w} k(z)F(kt)\,dz}{\int_0^H k(z)F(kt)\,dz} \quad . \quad . \quad . \quad . \quad . \quad (7)$$

*This simplification involves the further assumption that there is no "subordinate phase" or stripping of the residual oil behind the advancing water-oil interface. This will be further discussed later.

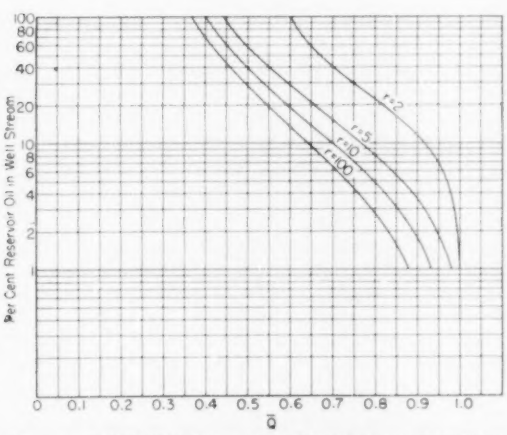

FIG. 3 – THE VARIATION OF THE OIL CONTENT IN THE PRODUCTION FROM EXPONENTIALLY STRATIFIED WATER-DRIVE RESERVOIRS WITH THE CUMULATIVE RECOVERY, FOR $\bar{m} = 0.1$; Q = CUMULATIVE RECOVERY, AS A FRACTION OF THE TOTAL RESERVOIR DISPLACEABLE RECOVERY. r = STRATIFICATION RATIO; m = (MOBILITY OF DISPLACED OIL)/(MOBILITY OF INVADING WATER).

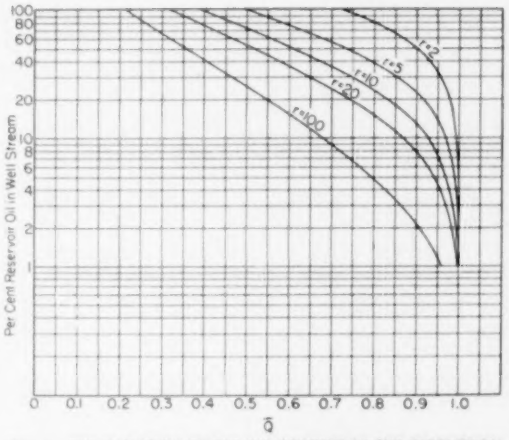

FIG. 4 – THE VARIATION OF THE OIL CONTENT IN THE PRODUCTION FROM EXPONENTIALLY STRATIFIED WATER-DRIVE RESERVOIRS WITH THE CUMULATIVE RECOVERY, FOR $\bar{m} = 1$; Q = CUMULATIVE RECOVERY, AS A FRACTION OF THE TOTAL RESERVOIR DISPLACEABLE RECOVERY. r = STRATIFICATION RATIO; $\bar{m}$ = (MOBILITY OF DISPLACED OIL)/(MOBILITY OF INVADING WATER).

where z_w is determined by the condition:

$$k(z_w) = \frac{\Psi(A\bar{I})}{t} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (8)$$

and represents the depth to which breakthrough has already occurred.

The cumulative oil production as a fraction of the total recoverable oil in the reservoir will then be:

$$Q(t) = \left[A \int_0^H \bar{f}\,dz + \int_0^{z_w} k(z)\,dz \int_0^t F(kt)\,dt\right] \Big/ A \int_0^H f\,dz \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (9)$$

If the permeability included in the net productive section has a non-vanishing lower limit, the production phase governed by Equations (7) and (8) will terminate after breakthrough in the tightest layer, as determined by Equation (4). Under the assumption of 100 per cent pattern efficiency, i.e., $S = 1$, this will necessarily terminate the whole oil production history, although in practice a limiting value of R_o will generally control the state of abandonment.

The Function F for Linear Flow

As a practical matter drastic simplifications must be made in applying the general equations developed above. As a first step a functional form must be derived for the function F. For this purpose the case of an ideal linear system will be assumed here as was done by Dykstra and Parsons,[5] since anything more complex which might be of practical significance would be virtually intractable from a strictly analytical standpoint.

It may be shown that the rate of throughflow per unit cross section at any time t in a linear system in which a liquid (w) is displacing another (o), may be expressed as:

$$Q = \frac{m_w \bar{f} a L/2}{\sqrt{1 - (1 - \bar{m})am_w t}}; \quad m = m_o/m_w; \quad a = \frac{2\bar{m}\triangle p}{\bar{f}L^2} \quad . \quad (10)*$$

*Equation (10) can be derived by applying the analysis given in "Flow of Homogeneous Fluids Through Porous Media," §8.3, for two-fluid linear encroachment systems.

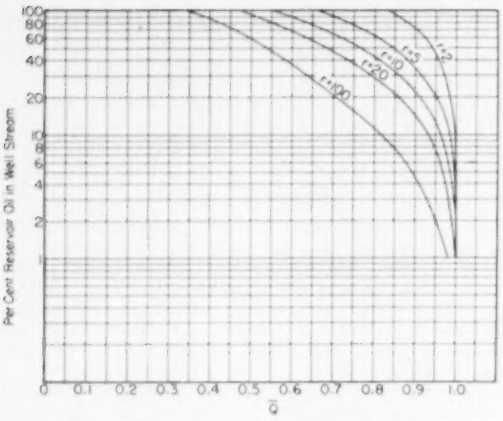

FIG. 5 — THE VARIATION OF THE OIL CONTENT IN THE PRODUCTION FROM EXPONENTIALLY STRATIFIED WATER-DRIVE RESERVOIRS WITH THE CUMULATIVE RECOVERY, FOR $\bar{m} = 10$; $\bar{Q}$ = CUMULATIVE RECOVERY AS A FRACTION OF THE TOTAL RESERVOIR DISPLACEABLE RECOVERY. r = STRATIFICATION RATIO; $\bar{m}$ = (MOBILITY OF DISPLACED OIL)/(MOBILITY OF INVADING WATER).

where m_o, m_w are the "mobilities" for the displacing and displaced fluids, L the total length of the system, Δp is the driving pressure differential, which is assumed to be constant,* and f is the net displacement porosity. The mobility is defined as the ratio of the effective permeability to the viscosity. By reference to Equation (1) it follows that the function F is given by:

$$F(kt) = \frac{faL\sqrt{2u_o}}{\sqrt{1-(1-\bar{m})am_o t}} \quad . \quad . \quad . \quad . \quad . \quad (11)$$

The cumulative throughflow per unit cross section to the time t will be, on integrating Equation (10):

$$\bar{Q}(t,z) = \frac{\bar{f}L}{1-\bar{m}}\left[1-\sqrt{1-(1-\bar{m})am_o t}\right] \quad . \quad (12)$$

The time for breakthrough is obtained by setting $\bar{Q}(t,z)$ equal to $\bar{f}L$, and is found to be:

$$t_b = \frac{1+\bar{m}}{am_o} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (13)$$

To proceed further it is necessary to specify the nature of the permeability, k or m_o, distribution.** Here, too, one must make, as a matter of practical necessity, a further simplification in considering that the mobility ratio $\bar{m}$ is a constant, independent of the absolute permeability. As to the permeability distributions themselves, the exponential and linear distributions will be analyzed in detail.

*It is also tacitly assumed throughout this work that at all times the pressures are above the bubble point, corresponding to a complete water drive operation of an undersaturated reservoir.

**Under the assumption that the relative permeabilities both ahead and behind the water-oil interfaces are independent of the homogeneous fluid permeabilities, the distributions of the latter, as given by Equation (14) or (21), will apply also to the effective permeabilities and mobilities which enter directly in the analysis.

EXPONENTIAL PERMEABILITY DISTRIBUTION

As in the case of the previous[1] study of cycling operations ($m = 1$), the exponential permeability distribution will be taken in the form:

$$k = k_{min}\, e^{bz/H}; \; b = \log r \quad . \quad . \quad . \quad . \quad . \quad . \quad (14)$$

where k_{min} is the minimum permeability, at $z = 0$, rk_{min} is the maximum permeability at $z = H$, H is the net thickness of the section and, as already indicated, the various strata are considered to be rearranged in a monotonic sequence increasing with depth. The parameter r defines the particular exponential distribution of interest, and will be termed the stratification ratio. It will also be assumed that there is no cross flow between the strata, which will not be strictly true unless the vertical permeability is zero, and that the net displacement porosity $\bar{f}$ is independent of k, which also will represent an approximation assumption.

Under these assumptions the total throughflow from the whole section at a time t before any breakthrough has developed, as a fraction of the total recoverable oil, will then be given essentially by integrating Equation (12), as:

$$\bar{Q}(t) = \frac{1}{(1-\bar{m})H}\int_0^H \left[1-\sqrt{1-(1-\bar{m})am_o t}\,\right] dz$$

$$= \frac{1}{1-\bar{m}}\left[1-\frac{2}{b}\left\{\sqrt{1-(1-\bar{m}^2)t/t_b}-\sqrt{1-(1-\bar{m}^2)t/rt_b}\right\}\right.$$

$$\left.\frac{1}{b}\log\frac{\sqrt{1-(1-\bar{m})t/t_b}-1}{\sqrt{1-(1-\bar{m})t/t_b}+1}+\frac{1}{b}\log\frac{\sqrt{1-(1-\bar{m})t/rt_b}-1}{\sqrt{1-(1-\bar{m})t/rt_b}+1}\right]$$

$$. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (15)$$

where t_b is the time of initial breakthrough, as given by:

$$t_b = \frac{(1+\bar{m})}{ar\, m_{o\,min}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (16)$$

$m_{o\,min}$ corresponding to k_{min}.

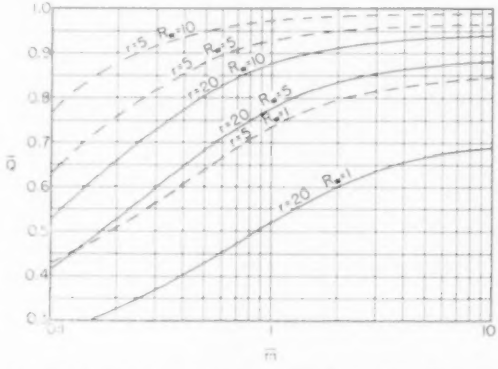

FIG. 6 — THE VARIATION OF THE CUMULATIVE RECOVERY, $\bar{Q}$, IN EXPONENTIALLY STRATIFIED WATER-DRIVE RESERVOIRS WITH THE MOBILITY RATIO $\bar{m}$, TO FIXED VALUES OF THE WATER-OIL RATIO R_w, AND FOR FIXED VALUES OF THE STRATIFICATION RATIO r. $\bar{Q}$ = CUMULATIVE RECOVERY AS A FRACTION OF THE TOTAL RESERVOIR DISPLACEABLE RECOVERY. $\bar{m}$ = (MOBILITY OF DISPLACED OIL)/(MOBILITY OF INVADING WATER).

At this time $\bar{Q}$ will have the value:

$$\bar{Q}(t_b) = \frac{1}{1-\bar{m}}\left[\, 1 - \frac{2}{b}\left\{ m - \sqrt{1-(1-\bar{m}^2)/r}\,\right\} - \frac{1}{b}\log\frac{m-1}{m+1} + \frac{1}{b}\log\frac{\sqrt{1-(1-\bar{m})/r}-1}{\sqrt{1-(1-\bar{m})/r}+1}\,\right] \quad \ldots\ldots\ldots\ldots (17)$$

After the initial breakthrough the cumulative fractional recovery will be, on applying Equations (10) and (14) to Equation (9):

$$\bar{Q}(t) = 1 - \frac{z_w}{H} + \frac{1}{(1-\bar{m})H}\int_{z_w}^{z_e} \left[1 - \sqrt{1-(1-\bar{m})\alpha r}\,\right] dz$$

$$= 1 + \frac{\bar{m}}{(1-\bar{m})b}\log\frac{r}{t} - \frac{1}{(1-\bar{m})b}\left[\, 2\left\{\bar{m} - \sqrt{1-(1-\bar{m})\frac{t}{t_b}r}\,\right\} + \log\frac{\bar{m}-1}{\bar{m}+1} - \log\frac{\sqrt{1-(1-\bar{m}^2)\frac{t}{t_b}r}-1}{\sqrt{1-(1-\bar{m})\frac{t}{t_b}r}+1}\,\right] \quad \ldots\ldots\ldots\ldots (18)$$

where z_w is the value of z above which there has been water breakthrough at the time t, and $\bar{t} = t/t_b$. The water-oil ratio will be:

$$R_w = \frac{Q_w}{Q_o} = \frac{\int_{z_w}^{z_e} k(z)F(kt)dz}{\int_{H}^{z_w} k(z)F(kt)dz} = \frac{(1-\bar{m}^2)(\bar{t}-1)}{2\bar{m}\left\{\sqrt{1-(1-\bar{m}^2)t/t_b r} - \bar{m}\right\}} \quad (19)$$

It will be readily verified that for $\bar{m} = 1$, as may be assumed for the case of cycling operations, Equations (17)-(19) reduce to:

$$\bar{Q}(t_b) = \frac{1}{rb}(r-1);\ t_b = \frac{\mu_w \bar{f} L}{r\triangle p k_{min}(e\beta)},$$
$$\bar{Q}(t>t_b) = \frac{1}{b}\left[\, 1 - \frac{1}{r} + \log\frac{r}{t}\,\right]$$
$$R_w = \frac{t-1}{1-1/r} \quad \ldots\ldots\ldots (20)$$

which agree with those derived for this case previously.

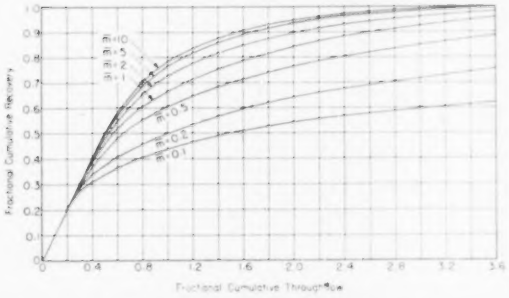

FIG. 7 — THE CUMULATIVE OIL RECOVERY HISTORY VS. THE TOTAL FRACTIONAL CUMULATIVE WATER AND OIL THROUGHFLOW IN EXPONENTIALLY STRATIFIED WATER-DRIVE RESERVOIRS FOR DIFFERENT VALUES OF THE MOBILITY RATIO, $\bar{m}$ = (MOBILITY OF DISPLACED OIL)/(MOBILITY OF INVADING WATER). IN ALL CASES THE STRATIFICATION RATIO = 20.

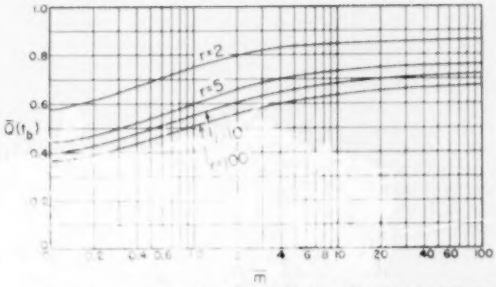

FIG. 2 — THE VARIATION OF THE INITIAL BREAKTHROUGH RECOVERY IN LINEARLY STRATIFIED SYSTEMS WITH THE MOBILITY RATIO OF THE INVADING AND DISPLACED FLUIDS. $\bar{Q}(t_b)$ = FRACTION OF TOTAL DISPLACEABLE OIL RECOVERED AT TIME OF INITIAL BREAKTHROUGH, t_b. $\bar{m}$ = (MOBILITY OF DISPLACED OIL)/(MOBILITY OF INVADING WATER); r = STRATIFICATION RATIO OF ASSUMED LINEAR PERMEABILITY DISTRIBUTION.

On the other hand, in the limit of $m \to \infty$, in which the invading fluid (water, m_w) has a negligible mobility as compared to that displaced (oil, m_o), Equations (17)-(19) reduce to:

$$\bar{Q}(t_b) = \frac{2}{b}\left(1 - \frac{1}{\sqrt{r}}\right);\ t_b = \frac{\mu_w \bar{f} L^2}{2r\triangle p k_{min}(e\beta)},$$
$$\bar{Q}(t>t_b) = 1 - \frac{1}{b}\log\frac{r}{t} + \frac{2}{b}\left(1 - \sqrt{\bar{t}/r}\right),$$
$$R_w = \frac{(\bar{t}-1)}{2(1-\sqrt{\bar{t}/r})} \quad \ldots\ldots\ldots (21)$$

And in the converse limit of $\bar{m} \to 0$, where the resistance to the invading fluid is negligible as compared to that displaced, the water-oil ratio will rise precipitously to infinite values immediately after initial breakthrough, and the total fractional recovery $\bar{Q}$ will be essentially that at t_b, as given by Equation (17) for $\bar{m} = 0$.

The values of the fractional flooding recovery at the time of first water breakthrough, $\bar{Q}(t_b)$, as given by Equation (17), are plotted vs. the mobility ratio $\bar{m}$ in Fig. 1 for fixed values of stratification ratio r. As previously anticipated, for $\bar{m} < 1$, i.e., when the mobility of the displacing fluid (water) exceeds that of the fluid displaced (oil) the bypassing tendency is accentuated and the breakthrough recovery is reduced. Conversely, when the mobility of the displacing fluid is lower than that displaced, $\bar{m} > 1$, the continued entry of the former in the higher permeability strata will automatically retard itself and the breakthrough recovery will be increased. These effects increase with increasing stratification ratios r. The ratio of maximum breakthrough recovery, for $\bar{m} = \infty$, to the minimum at $\bar{m} = 0$, is plotted vs. r in Fig. 2. The total maximum range of the effect of the mobility contrast is 3.26, for $r = \infty$.

Because of the rapid buildup of the water production after initial breakthrough, especially for $\bar{m} < 1$, it is difficult to devise a satisfactory graphical representation of this later phase of the production history in terms of the water-oil ratio R_w. It has been found preferable to use as an index the percentage of oil in the composite fluid stream, in reservoir measure. This quantity, denoted by R_o, will be given simply by $1/(1+R_w)$, and is plotted vs. the cumulative fractional displaceable oil recovery, for fixed values of stratification ratio r and several values of mobility ratio $\bar{m}$ in Figs. 3-5.

The starting points of the curves of these figures represent the initial breakthrough recoveries. The general shifts of the curves, for mixed $\overline{m}$, to the right as r decreases, are of course to be expected apriori. It is of interest to note, however, that whereas for $\overline{m}<1$, Fig. 3, the systems with lowest breakthrough recoveries, greatest values of r, have the steepest initial rates of fall in oil content of the flow stream, the converse is true for $\overline{m}>1$, Fig. 5. Moreover, whereas for $\overline{m}<1$, the curves tend to be initially concave upward, they ultimately develop steep slopes, for all mobility ratios m, as the oil content of the flow stream becomes small and complete flooding develops throughout the reservoir.

Figs. 3-5 show that the differences in ultimate oil recoveries for reservoirs with different stratification and fluid characteristics will be considerably lower if the operations are continued to low oil contents than at initial water breakthrough. Thus, for $\overline{m}=0.1$ the recovery at one per cent oil content in the well stream will be only 30 per cent greater for $r=2$ than for $r=100$, whereas the breakthrough recovery for $r=2$ will be 3.7 times as great as for $r=100$. For $\overline{m}=10$, the recovery at one per cent oil content for $r=2$ will exceed that for $r=100$ by only about two per cent, as compared to a ratio of 2.4 at initial breakthrough. Similarly for r fixed at 20, the breakthrough recoveries for $\overline{m}=10$ and 0.1 are in the ratio of 2.2, whereas the recoveries at one per cent oil content are in the ratio of only 1.06.

The variation of the recoveries to fixed water-oil ratio, R_w, with the value of $\overline{m}$, for several values of r, is plotted in Fig. 6. Here again will be seen the effect of increasing mobility ratio $\overline{m}$ in improving the resultant recoveries. It will be noted, too, that the recoveries are more sensitive to $\overline{m}$ in the range $\overline{m}<1$ than for $\overline{m}>1$. The gross comparative positions of the curves reflect the degree of reservoir stratification and the limiting water-oil ratios to which the production is continued.

The oil recovery vs. total throughflow or production history can be calculated from the relation (valid for $1 \leq \bar{t} \leq r$):

$$\bar{V}(\bar{t}) = \bar{Q}(\bar{t}) + \frac{1+\overline{m}}{2\overline{m}b}\left[\bar{t} - 1 - \log \bar{t}\right] \quad . \quad . \quad . \quad (22)$$

where $\bar{V}(\bar{t})$ is the cumulative total liquid production, in reservoir volume, expressed in units of the total displaceable reservoir liquid content. $\bar{Q}(\bar{t})$ is the cumulative fractional oil recovery given by Equation (18). A typical set of production history curves calculated by Equations (22) and (18) are those plotted in Fig. 7 for a stratification ratio $r=20$. The effect of the mobility ratio $\overline{m}$ is here strikingly shown by comparative values of the cumulative throughflow, $\bar{V}$, for equal total recoveries, and especially at high values of the latter. Thus, at a total fractional recovery of 35 per cent the total fractional throughflow would be 0.35, 0.36, and 0.55 for $\overline{m}=10$, 1, 0.1; at a recovery of 50 per cent these would be 0.51, 0.57 and 1.5 respectively; and for 80 per cent cumulative recovery the corresponding fractional throughflows or total reservoir fluid production would be 1.06, 1.68 and 8.0 for $\overline{m}=10$, 1 and 0.1 respectively.

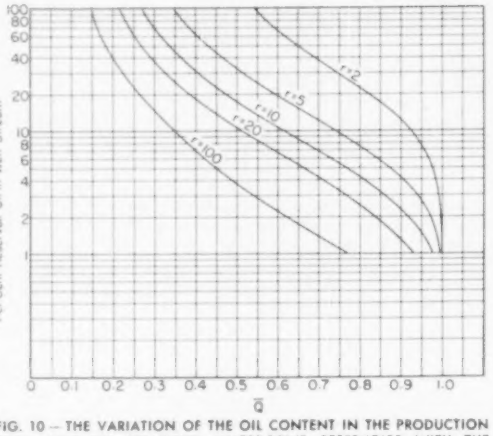

FIG. 10 — THE VARIATION OF THE OIL CONTENT IN THE PRODUCTION FROM LINEARLY STRATIFIED WATER-DRIVE RESERVOIRS WITH THE CUMULATIVE RECOVERY, FOR $m=0.1$; Q = CUMULATIVE RECOVERY, AS A FRACTION OF THE TOTAL RESERVOIR DISPLACEABLE RECOVERY. r = STRATIFICATION RATIO; $\overline{m}$ = (MOBILITY OF DISPLACED OIL)/(MOBILITY OF INVADING WATER).

LINEAR PERMEABILITY DISTRIBUTION

The linear permeability distribution may be defined by:

$$k(z) = k_{min}\left[1 + (r-1)z/H\right] \quad . \quad . \quad . \quad (23)$$

where here, too, the stratification ratio r is the ratio of the maximum permeability rk_{min} at $z=H$, to the minimum k_{min} at $z=0$. The total throughflow at a time t before breakthrough has developed, as a fraction of the total recoverable oil, will be, analogous to Equation (15):

$$\bar{Q}(t) = \frac{1}{(1-\overline{m})H}\int_0^H \left[1 - \sqrt{1-(1-\overline{m})am_w t}\right]dz$$

$$= \frac{1}{1-\overline{m}}\left[1 + \frac{2}{3b}\left\{(a-b)^{3/2} - a^{3/2}\right\}\right] \quad . \quad (24)$$

where:

$$a = 1-(1-m^c)\bar{t}/r; \quad b = (1-m^c)(r-1)\bar{t}/r;$$
$$\bar{t} = t/t_b; \quad t_b = \frac{(1+\overline{m})\mu_w}{ar\,k_{min}} \quad . \quad . \quad . \quad . \quad . \quad . \quad (24a)$$

The fractional recovery at first water breakthrough, i.e., $\bar{t}=1$, will then be:

$$\bar{Q}(t_b) = \frac{1}{1-\overline{m}}\left[1 + \frac{2r}{3(r-1)(1-m^c)}\left\{\overline{m}^c - (1-(1-m^c)/r)^{3/2}\right\}\right]$$
$$. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (25)$$

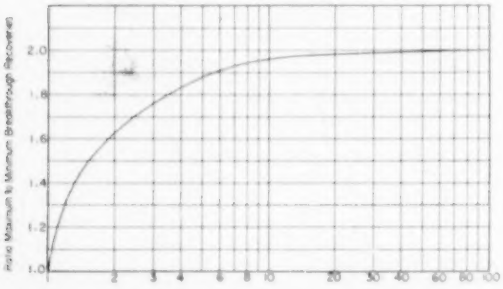

FIG. 9 — THE VARIATION OF THE RATIO OF MAXIMUM TO MINIMUM WATER BREAKTHROUGH RECOVERIES IN LINEARLY STRATIFIED MEDIA WITH THE STRATIFICATION RATIO r, FOR THE LIMITS OF INFINITE AND VANISHING MOBILITY RATIOS.

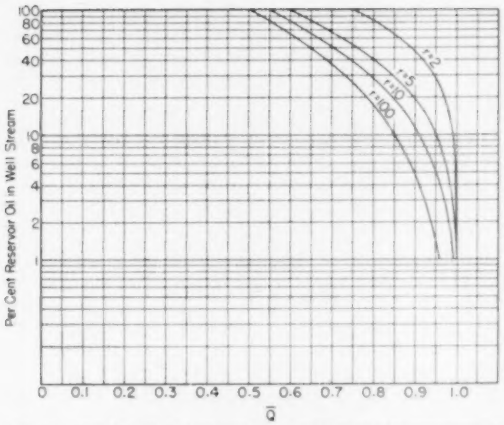

FIG. 11 — THE VARIATION OF THE OIL CONTENT IN THE PRODUCTION FROM LINEARLY STRATIFIED WATER-DRIVE RESERVOIRS WITH THE CUMULATIVE RECOVERY, FOR $m = 1$; Q = CUMULATIVE RECOVERY, AS A FRACTION OF THE TOTAL RESERVOIR DISPLACEABLE RECOVERY. r = STRATIFICATION RATIO; $\bar{m}$ = (MOBILITY OF DISPLACED OIL)/(MOBILITY OF INVADING WATER).

After the initial water breakthrough, $\bar{t} > 1$, the cumulative recovery will be:

$$\bar{Q}(t) = 1 - \frac{z_w}{H} + \frac{1}{(1-\bar{m})H} \int_0^{z_w} [1 - \sqrt{1-(1-\bar{m})am_w t}]\,dz$$

$$= 1 + \frac{\bar{m}}{1-\bar{m}} \frac{(r/\bar{t}-1)}{r-1} + \frac{2r/\bar{t}}{3(1-\bar{m})(1-\bar{m}^2)(r-1)} \{\bar{m}^3 - a^{3/2}\} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (26)$$

where z_w is the value of z above which there has been water breakthrough. It will be noted that at $\bar{t} = 1$, Equation (26) becomes equivalent to Equation (25). And at the time of breakthrough in the tightest layer, $t = r$, $\bar{Q}$ becomes unity, as it should under the assumed conditions.

The water-oil ratio during this period is given by:

$$R_w = \frac{Q_w}{Q_o} = \frac{3(1-\bar{m}^2)^2(\bar{t}-1)}{4m} \Bigg/ \left[\left\{ \frac{1}{2} + (1-\bar{m}^2)\frac{t}{r} \right\} \sqrt{1-(1-\bar{m}^2)\bar{t}/r} - \bar{m}(3-\bar{m}) \right] \quad . \quad . \quad (27)$$

In the limit of $\bar{m} = 1$, corresponding to cycling operations, R_w reduces, as it should, to:

$$R_w = \frac{\bar{t}^2 - 1}{1 - \bar{t}^2/r^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (28)$$

It will be noted, too, that at $t = 1$, $R_w = 0$, and that it becomes indefinitely large as t approaches r.

The total reservoir fluid throughflow, in units of the total displaceable reservoir content volume, may be shown to be given by:

$$\text{Throughflow} = \bar{Q}(t): \quad 0 \leq t \leq 1$$

$$= \bar{Q}(t) - \frac{r(1+\bar{m})}{2\bar{m}(r-1)} \left[1 - \frac{1}{2}(\bar{t} + \frac{1}{\bar{t}}) \right] ; \quad 1 \leq t \leq r \quad . \quad (29)$$

The variation of the initial breakthrough recoveries with the mobility ratio $\bar{m}$, as given by Equation (25), for fixed values of r is plotted in Fig. 8. The general shapes of these curves, reflecting the effect of the mobility ratio on the breakthrough recovery, is similar to that shown in Fig. 1 for the exponential permeability distribution. As a whole the curves of Fig. 8 lie higher than those of Fig. 1, showing that for the same stratification constant and mobility parameter the linear permeability distribution represents a type of reservoir non-uniformity which is not as serious as the exponential distribution. This is further indicated by the closer grouping of the curves of Fig. 8 than the corresponding ones for Fig. 1, which again shows that the effects of the permeability variation will be much more limited when distributed linearly than when it varies exponentially. In fact, whereas the breakthrough and subsequent recoveries become vanishingly small as r approaches infinity for the exponential distribution, the breakthrough recovery approaches the non-vanishing limit $(2\bar{m}+1)/3(1+\bar{m})$ as r becomes infinitely large in the linear permeability distribution.

The gross overall effect of the mobility ratio in the linearly stratified formations, as expressed by the ratio of the maximum to minimum water breakthrough recoveries, is plotted vs. the stratification ratio r in Fig. 9. These represent the ratios $\bar{Q}(t_b)$ for $\bar{m} = \infty$ to that for $\bar{m} = 0$. The curve of Fig. 9 is of the same general shape as that of Fig. 2 for the exponentially stratified system, except that the maximum asymptotic limit has here the value 2.0, as compared to 3.26 in Fig. 2. This once more reflects the smaller total effect of permeability non-uniformity when distributed according to a linear stratification as compared to that when it follows an exponential distribution.

The resultant production histories after first water breakthrough in the linearly stratified systems are plotted in Figs. 10-12. Here, as in the case of the exponential distributions, the ordinates represent the per cent reservoir oil in the composite well stream, and the abscissas are the cumulative fractional oil recoveries. The uppermost points of the various curves give the breakthrough recoveries. The general characteristics of this set of curves are similar to those for the exponential distributions plotted in Figs. 3 to 5. Once again the

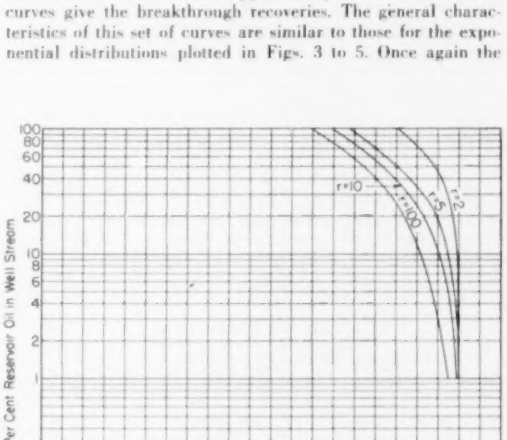

FIG. 12 — THE VARIATION OF THE OIL CONTENT IN THE PRODUCTION FROM LINEARLY STRATIFIED WATER-DRIVE RESERVOIRS WITH THE CUMULATIVE RECOVERY, FOR $m = 10$; Q = CUMULATIVE RECOVERY, AS A FRACTION OF THE TOTAL RESERVOIR DISPLACEABLE RECOVERY. r = STRATIFICATION RATIO; $\bar{m}$ = (MOBILITY OF DISPLACED OIL)/(MOBILITY OF INVADING WATER).

more limited effects of the differential mobility in the linearly stratified system are exhibited by the closer grouping of the curves for different stratification constants and their general shift toward the region of higher recoveries. It is for the former reason that in Figs. 10-12 the curves for $r = 20$ have been omitted, because of the small separation between the curves for $r = 10$ and $r = 100$. It will be noted, too, on comparison of the corresponding figures for the linearly and exponentially stratified systems, that while as a group the curves for the former are shifted toward the right, those for the same values of r for the two types of stratification ultimately cross, so as to result in somewhat lower cumulative oil recoveries at very low oil contents in the linearly stratified formations. The general effect of the mobility ratio m is again the same for the linear case as it is for the exponential case. That is, the curves shift toward increasing recoveries as m is increased, and they become grouped more closely for the different values of the stratification constant. This implies that the effect of the permeability variation will be less serious the higher the value of the mobility ratio m.

The variation of the recoveries to fixed water-oil ratios R_o with the mobility ratio m, for the two values of r, is plotted in Fig. 13. The similarities and differences between the curves of Fig. 13 and the corresponding ones in Fig. 6 for the exponential distribution are quite apparent, and of the same character as discussed with respect to the composition history curves of Figs. 10-12.

A set of curves, similar to those of Fig. 7, illustrating the cumulative oil recovery vs. the total reservoir fluid production histories is given in Fig. 14 for $r = 20$ in the linear permeability distribution. The implications of these curves are similar to those noted with respect to Fig. 7, and need no further specific discussion.

For the sake of completeness the results analogous to those of Figs. 6 and 13 for the probability distribution have been replotted in Fig. 15 from graphs of Dykstra and Parsons.[7] The parameter characterizing the probability distribution is here the "variation," V, which is related to the standard deviation σ of the probability distribution by:

$$V = 1 - 2^{-\sigma} \quad \ldots \ldots \ldots \quad (30)$$

V ranges between 0 and 1 as the corresponding formation changes from one of complete uniformity to infinite variability. It will be seen that the general features of the curves in Fig. 15 are similar to those of Figs. 6 and 13, although the quantitative effect of the mobility ratio m seems to be somewhat less in the case of the probability distribution than in either of the other distributions.

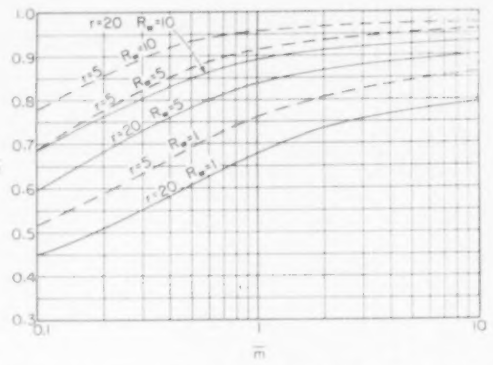

FIG. 13 — THE VARIATION OF THE CUMULATIVE RECOVERY, Q, IN LINEARLY STRATIFIED WATER-DRIVE RESERVOIRS WITH THE MOBILITY RATIO m, TO FIXED VALUES OF THE WATER-OIL RATIO R_o, AND FOR FIXED VALUES OF THE STRATIFICATION RATIO r. $\bar{Q}$ = CUMULATIVE RECOVERY AS A FRACTION OF THE TOTAL RESERVOIR DISPLACEABLE RECOVERY. m = (MOBILITY OF DISPLACED OIL)/(MOBILITY OF INVADING WATER).

DISCUSSION

While the general features of the implications of the theory of the performance of stratified water drive reservoirs have been discussed above, it must be understood that the basic theory involves three fundamental assumptions.

These are: (1) idealized stratification, (2) 100 per cent areal or pattern sweep efficiency, and (3) the absence of stripping action behind the water-oil interface. It is virtually necessary to make each of these assumptions in order to develop a tractable formulation of the theory. However, it is well to understand what their physical implications are and the possible effect they may have on the final numerical results which are calculated by the simplified theoretical analysis.

The assumption of idealized stratification will certainly never be satisfied in practice. Its significance lies only in the concept that it may provide a statistical equivalence to the actual non-uniformity in permeability which does obtain in the producing formation. Such equivalence may be valid, at least in an approximate degree, under conditions where the invading and displaced fluids have the same mobilities, as is generally assumed in the case of cycling operations and which is represented by the special case of $m = 1$ in the generalized analytical theory. The steady state pressure and flow distributions under such conditions may then be represented by a steady state type of streamline distribution, which automatically provides a type of stratification which is at least analogous to that assumed in the analytical treatment. The assumption of vanishing cross-flow, which is an integral part of the idealized stratification concept, is then also automatically satisfied in the actual steady state streamline system, although microscopically the resultant streamline stratification will in no sense be coincident with the strictly parallel stratification assumed in the theory.

However, when the mobilities of the displaced and invading fluids are different, the instantaneous steady state representations will continually change as the water invasion proceeds, and with such changes will be associated new streamline distributions. The assumption of vanishing cross-flow will then no longer be valid unless by accident the cross-bedding permeability happens to be strictly zero. It is clear, therefore, that the concept of idealized stratification can at best represent only an extreme simplification. On the other hand, aside from the realistic necessity of making such an assumption in order to arrive at a tractable analysis, it does have the further justification that it probably represents the least favorable type of permeability non-uniformity, as compared to those which actually occur, from the point of view of the initial breakthrough recovery. That is, the simplified theory should at least give minimum values of the breakthrough recoveries. It also seems probable that the recovery history after breakthrough will also be inherently less favorable under idealized stratification and vanishing cross-flow than under actual conditions where there are both two and three dimensional variations of permeability. From this point of view the theory has value in providing at least lower limits for the recovery possibilities in non-uniform water-drive systems, thus giving the least favorable expectations for the performance of such

reservoirs. Since it is not feasible to treat arbitrary types of reservoir non-uniformity, it is felt that means for fixing at least the poorest recovery potentialities of the actual reservoir systems does represent a constructive contribution to their analysis.

The assumption of perfect areal or pattern sweep efficiency will also never be valid in practice. It may be recalled, however, that in the earlier study of cycling operations in exponentially stratified reservoirs it was found that the effect of imperfect areal sweep efficiency was rather minor compared to the direct effect of the stratification, except in reservoirs of a very high degree of uniformity. It seems likely, therefore, that in actual producing formations the simplification made in assuming perfect areal pattern sweep efficiency will not in itself cast serious doubt on the significance of the results.

The final major assumption made in the theory developed here lies in assuming that there is no oil stripping in the flooded part of the formation and behind the advancing water-oil interface. This may be expressed by the assumption that the permeability to the oil behind the water-oil interface* is 0. A theory was developed some time ago[6] in which the advance of water in an oil bearing system was analyzed under the more general assumption that the permeability to the oil remained non-vanishing even after passage of the water front. This led to a separation of the composite well producing history into a primary phase corresponding to the displacement of the oil bank ahead of the water-oil interface and a subsequent subordinate phase giving the history of the continued stripping of the oil beind the water-oil front. This latter phase is determined primarily by the relative permeabilities and viscosities to the water and oil behind the water front.

This theory is based on a simple and straightforward application of relative permeability concepts. For the linear** water-flooding system it leads to an equation for the saturation distribution at any time t which may be expressed as:

$$x = \frac{Qt}{f}\frac{dF_w}{d\rho} + \Phi(\rho_w) \quad . \quad . \quad . \quad . \quad (31)$$

*As previously noted, it has been further assumed that the amount of this residual oil is independent of the absolute permeability, since satisfactory data are not available on the relationship, if any, between these parameters.

**It may be readily shown that in the similar case of perfect radial systems, Equation (31) will still apply provided x is replaced by πr^2.

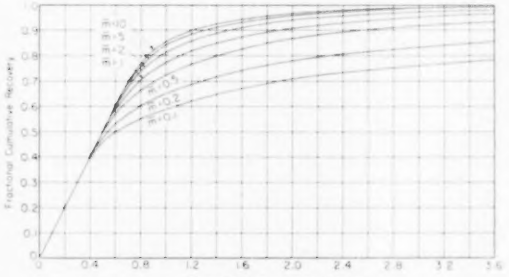

FIG. 14 — THE CUMULATIVE OIL RECOVERY HISTORY VS. THE TOTAL FRACTIONAL CUMULATIVE WATER AND OIL THROUGHFLOW IN LINEARLY STRATIFIED WATER-DRIVE RESERVOIRS FOR DIFFERENT VALUES OF THE MOBILITY RATIO, m = (MOBILITY OF DISPLACED OIL)/(MOBILITY OF INVADING WATER). IN ALL CASES THE STRATIFICATION RATIO = 20.

where Q is the constant rate of throughflow, f the porosity, F_w the water fraction of the local flow-stream, and $\Phi(\rho_w)$ defines the initial saturation distribution. F_w is given explicitly by:

$$F_w = \frac{m_w}{m_o + m_w} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (32)$$

where m_w, m_o are the mobilities of the water and oil respectively. While Equation (31) apparently involves no basic physical approximations except for the neglect of capillary pressure effects, it leads to the curious and physically meaningless result that the saturation distribution ahead of the initial interface will be multiple-valued.* As noted by Buckley and Leverett,[7,8]** this difficulty may be circumvented when applying the theory by arbitrarily imposing a sharp single valued front at the advanced interface, on requiring that the total increase in water content of the flooded area equal the total volume of invading water. From a physical standpoint, however, it is far from satisfying to have to resort to such an artifice, and the fundamental significance of the whole procedure still remains obscure. Moreover, question may be raised if the relative permeability concepts, as derived from multiphase systems in which two or more phases are continually supplied for flow across each internal cross section, are inherently applicable to displacement processes occurring at the advancing front of an identifiable wetting phase displacing liquid. Intuitively, at least, it is conceivable that under the latter conditions the non-wetting phase would be stripped locally to a discontinuous distribution of vanishing permeability as soon as it has been invaded and passed by the wetting phase "front."

Finally, it may be noted that because of the approximate symmetry of F_w and F_w' for unconsolidated sands about the saturation for maximum slope, when the oil and water viscosities are equal, Equation (31) when applied† to "oil flooding" of a water sand would give essentially the same type of invasion history as for water flooding. This, however, is hardly to be expected in view of the differential wettability between oil and water, and even though the relative permeabilities themselves presumably reflect these wettability differences.

In spite of these theoretical questions regarding the validity of Equation (31), it has apparently served to give a correlation of laboratory water-flooding data.[7] The effect of the water-oil viscosity ratio on the breakthrough recoveries appears to be subject to at least semi-quantitative description by Equation (31). Especially in the range of low invading fluid mobilities, as compared to that of the displaced fluid, the breakthrough recoveries are particularly low, and the corresponding subordinate phase recoveries become of comparable magnitude. While the permeability stratification theory would qualitatively give similar effects, it is admittedly doubtful if in these particular experiments permeability non-uniformity was the controlling factor. If these experimental results and the other implications of Equation (31) should be extended and confirmed for other systems, it will, of course, be neces-

*This ambiguity does not arise when F_w is a linear function of ρ_w or increases monotonically with ρ_w. In the former case, which implies linear k_w and k_o curves, the original water-oil boundary will advance without distortion, and in the latter initial distributions in which ρ_w decreases with x will continually become more stretched out.

**Although the inclusion of the capillary pressure term may formally resolve this ambiguity, the quantitative features of the distributions would then also be modified.

†For oil flooding, Equation (31) retains its general form with ρ_w replaced by ρ_o and F_w by $F_o = 1 - F_w$. When F_w and F_o are not symmetrical for equal viscosities, it may be possible to make them symmetrical by choosing a suitable viscosity ratio.

sary to accept its basic validity even though it has not been fully clarified in all respects.

While these considerations cast doubt on the predominating importance of the permeability non-uniformity in controlling actual water-drive recoveries, the stratification theory presented here should give the implications of at least one major factor in the recovery processes. If the validity of Equation (31) and its underlying concepts should become definitely established, it will be appropriate to consider the composite effect of these two factors. In principle, it should be possible to develop a superposition treatment, analogous to the manner in which the incompleteness of the pattern efficiency was incorporated in the theory of cycling in exponentially stratified media.[9] While it would be hazardous to predict the resultant production histories without making quantitative calculations, it seems reasonable to anticipate that the composite effect would correspond to surprisingly low breakthrough and subsequent recoveries under conditions which could occur in practice. Thus for $r = 20$ in the exponentially stratified distribution, the breakthrough recovery would be only 23 per cent for $\overline{m} = 0.2$ even for sharp water-oil interfaces. And in a uniform stratum the breakthrough recovery for a water-oil viscosity ratio of 0.2 would probably be about 50 per cent or less according to Equation (31). Although the superimposed resultant will not be the simple product of these two factors, the net theoretical effect will undoubtedly indicate discouragingly low breakthrough and overall recoveries. It is evident that this whole subject warrants a great deal of further experimental and theoretical study.

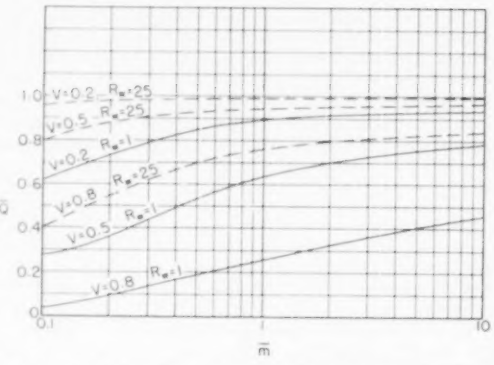

FIG. 15 — THE VARIATION OF THE CUMULATIVE RECOVERY, Q, IN STRATIFIED WATER-DRIVE RESERVOIRS WITH PROBABILITY PERMEABILITY DISTRIBUTIONS, WITH THE MOBILITY RATIO $\overline{m}$, TO FIXED VALUES OF THE WATER-OIL RATIO R_o, AND FOR FIXED VALUES OF THE "VARIATION" PARAMETER V. Q = CUMULATIVE RECOVERY AS A FRACTION OF THE TOTAL RESERVOIR DISPLACEABLE RECOVERY. $\overline{m}$ = (MOBILITY OF DISPLACED OIL)/(MOBILITY OF INVADING WATER).

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REFERENCES

1. W. Hurst and A. F. Van Everdingen: *Trans.* AIME (1946), **165**, 35.
2. M. Muskat: *Trans.* AIME (1949), **179**, 313.
2. M. B. Standing, E. W. Lindblad, R. L. Parsons: *Trans.* AIME (1948), **174**, 165.
4. M. Muskat: *Physics* (1934), **5**, 250.
5. H. Dykstra and R. L. Parsons: API meetings, Los Angeles, May, 1948.
6. S. E. Buckley and M. C. Leverett: *Trans.* AIME (1942), **146**, 107.
7. H. C. Brinkman: *App. Sci. Res.* (1949), **1**, 333.
8. J. P. Everett, F. W. Gooch, Jr., and J. C. Calhoun, Jr.: AIME meetings, San Antonio, Texas, Oct., 1949.
9. M. Muskat: *Trans.* AIME (1948), **179**, 216.

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INDEX TO TRANSACTIONS, VOLUME 189

(Plus Reference to Articles and Technical Notes Published in Journal of Petroleum Technology in 1950)

A

ALLEN, F. H., et al.: *Performance Characteristics of a Volumetric Condensate Reservoir*, 83

B

BALDWIN, W. F.: *Carter Reservoir Analyzer Timing Circuit* (Tech. Note), Nov. JPT

BEESON, CARROLL M.: *The Kobe Porosimeter and the Oilwell Research Porosimeter*, 313

BERLIN, E. W., et al.: *1949 — A Year of World-Wide Production Growth* (Art.), May JPT

BORDEN, GRANVILLE S.: Taxation Vs. Mineral Resources (Art.), Apr. JPT

BORDEN, GUY, JR., et al.: *Correlation of Bottom Hole Sample Data*, 345

BOWERS, EMIL F., et al.: *Performance of the Lower Pawelek Reservoir, Falls City Field, Karnes County, Texas*, 335

BOYD, WILLIAM L., et al.: *The Water Vapor Content of Essentially Nitrogen-Free Natural Gas Saturated at Various Conditions of Temperature and Pressure*, 241

BROWNSCOMBE, E. R., et al.: *Pressure Distribution in Unsaturated Oil Reserves* (Tech. Note), Oct. JPT

BUBB, F. W., et al.: *An Electronic Analog Computer for Solving the Flash Vaporization Equilibrium Equation*, 143

BURDINE, N. T., et al.: *Pore Size Distribution of Petroleum Reservoir Rocks*, 195

BUSH, ROBERT E., et al.: *Some Preliminary Investigations of Quantitative Interpretations of Radioactivity Logs*, 19

C

CALHOUN, JOHN C., JR., et al.: *Liquid-Liquid Displacement in Porous Media As Affected by the Liquid-Liquid Viscosity Ratio and Liquid-Liquid Miscibility*, 215

CALLAWAY, F. H., et al.: *Critical Analysis of the Effect of Well Density on Recovery Efficiency*, 269

CARPENTER, P. G., et al.: *An Electronic Analog Computer for Solving the Flash Vaporization Equilibrium Equation*, 143

Casing: Relative productivity of perforated casing, 179, 323
Effect on well productivity of penetration beyond perforated casing, 309

Cement: Squeeze cementing operations, 53
Variable weighting of cement slurries (Tech. Note), Dec. JPT

CLARK, ROSCOE E., JR.: *Influence of Different Types of Formation Waters on Disintegration of Cements* (Tech. Note), Aug. JPT

COLLINS, FRANCIS, et al.: *Pressure Distribution in Unsaturated Oil Reserves* (Tech. Note), Oct. JPT

COQUERON, FREDERICK G., et al.: *Financing Transactions of the Petroleum Industry in 1949* (Art.), Feb. JPT

Cores: Analysis of fractured limestone cores, 225
Mounting cores in thermoplastics (Art.), Dec. JPT

Corrosion: Within dehydrating tanks, 175

CRAZE, R. C.: *Performance of Limestone Reservoirs*, 287

CRUTCHFIELD, JOHN W., et al.: *Performance of the Lower Pawelek Reservoir, Falls City Field, Karnes County, Texas*, 335

CULBERSON, O. L., et al.: *Phase Equilibria in Hydrocarbon-Water Systems I*, 1

CULBERSON, O. L., et al.: *Phase Equilibria in Hydrocarbon-Water Systems II*, 319

Cycling operations: In the La Gloria Field, 281

D

Dehydrating tanks: Corrosion mitigation, 175

DEWITT, SAM N., et al.: *High Pressure Water Injection for Maintaining Reservoir Pressures, New Hope Field, Franklin County, Texas*, 325

DOLL, H. G.: *Selective SP Logging*, 129

DOLL, H. G.: *The MicroLog — A New Electrical Logging Method for Detailed Determination of Permeable Beds*, 155

DOLL, H. G.: *The SP Log in Shaly Sands*, 205

DOTY, E. C., et al.: *Improvements in the X-Ray Saturation Technique of Studying Fluid Flow*, 183

Drilling mud: Ability to lift bit cuttings, 35

DUCE, JAMES T., et al.: *1949 — A Year of World-Wide Production Growth* (Art.), May JPT

DYES, A. B., et al.: *The Estimation of Permeability and Reservoir Pressure from Bottom Hole Pressure Build-up Characteristics*, 91

Dynamometer charts and well weighing, 165

E

Electric logs: The presence of conductive solids in reservoir rocks as a factor in interpretation, 47
Quantitative evaluation of the physical characteristics of reservoir rock, 105
Selective SP logging, 129
MicroLog, 155
SP log in shaly sands, 205
Estimation of interstitial water from electric logs, 295

Ellensberger, Richard A.: *Methods of Treating Water for Flooding Purposes* (Art.), Aug. JPT
Everett, J. P., et al.: *Liquid-Liquid Displacement in Porous Media As Affected by the Liquid-Liquid Viscosity Ratio and Liquid-Liquid Miscibility*, 215

F

Fagg, L. W.: *Dynamometer Charts and Well Weighing*, 165
Fairlie, John F.: *The Significance of Recent Canadian Oil Developments* (Art.), Nov. JPT
Fast, C. R., et al.: *Squeeze Cementing Operations*, 53
Field histories: Volumetric Behavior of Oil and Gas from a Louisiana Field, 261
Study of reservoir performance of the First Grubb Pool, San Miguelito Field, 243
Review of cycling operations in the La Gloria Field, 281
High pressure water injection for maintaining pressures, New Hope Field, 325
Performance of Lower Pawelek Reservoir, Falls City Field, 335
Flash vaporization: Electronic analog computer for solving flash vaporization equilibrium equation, 143
Fluid flow: X-ray saturation technique, 183
Frailing, W. G., et al.: *Lakeview Pool, Midway-Sunset Field*, 7

G

Gas: Relative permeability, 65
Determining friction factors for measuring productivity of gas wells, 73
Gas wells: Determining friction factors for measuring productivity, 73
Gilmore, Robert B., et al.: *1949—A Year of World-Wide Production Growth* (Art.), May JPT
Glenn, Wayne E.: *A Study of Reservoir Performance of the First Grubb Pool, San Miguelito Field, Ventura County, Calif.*, 243
Gooch, F. W., Jr., et al.: *Liquid-Liquid Displacement in Porous Media As Affected by the Liquid-Liquid Viscosity Ratio and Liquid-Liquid Miscibility*, 215
Gournay, L. S., et al.: *Pore Size Distribution of Petroleum Reservoir Rocks*, 195
Greiffer, Bernard, et al.: *Anomalies in the Measurement of Wetting Liquid Pressure Gradients* (Tech. Note), June JPT
Grove, B. H., et al.: *1949—A Year of World-Wide Production Growth* (Art.), May JPT

H

Hall, H. N., et al.: *Ability of Drilling Mud to Lift Bit Cuttings*, 35
Hopkins, George B.: *A Projection of Oil Discovery from 1949 to 1965* (Art.), June JPT
Horn, Albert B., et al.: *Phase Equilibria in Hydrocarbon-Water Systems*, 1
Howard, George C., et al.: *Squeeze Cementing Operations*, 53
Howard, Robert A., et al.: *Relative Productivity of Perforated Casing—I*, 179
Howard, Robert A., et al.: *Relative Productivity of Perforated Casing—II*, 323
Hutchinson, C. A., Jr., et al.: *The Estimation of Permeability and Reservoir Pressure from Bottom Hole Pressure Build-up Characteristics*, 91
Hydrocarbon-water systems—phase equilibria, I, 319

I

Injection: High pressure water injection for maintaining reservoir pressures, 325
Interstitial water: Estimation from electric logs, 295

J

Jenks, L. H., et al.: *Relative Permeability to Gas*, 65
Johnson, J. W., et al.: *The Force Exerted by Surface Waves on Piles*, 149
Justice, W. H.: *Review of Cycling Operations in the La Gloria Field*, 281

K

Kartinen, Ernest O.: *Corrosion Mitigation within Dehydrating Tanks*, 175
Katz, Donald L., et al.: *The Coexistence of Liquid and Vapor Phases at Pressure above 10,000 PSI*, 119
Kaufman, Godfrey F., et al.: *1949—A Year of World-Wide Production Growth* (Art.), May JPT.
Keller, W. O., et al.: *Critical Analysis of the Effect of Well Density on Recovery Efficiency*, 269
Kelton, Frank C.: *Analysis of Fractured Limestone Cores*, 225

L

Lakeview Pool, Midway-Sunset Field, 7
Leas, W. J., et al.: *Relative Permeability to Gas*, 65
Lilienthal, W. B.: *Stainless Steel Containers for Laboratory Drilling Mud Test Work* (Tech. Note), Apr. JPT

Mc

McCarthy, Eugene L., et al.: *The Water Vapor Content of Essentially Nitrogen-Free Natural Gas Saturated at Various Conditions of Temperature and Pressure*, 241
McDowell, J. M., et al.: *Improvements in the X-Ray Saturation Technique of Studying Fluid Flow*, 183
McDowell, J. M., et al.: *The Effect on Well Productivity of Formation Penetration Beyond Perforated Casing*, 309
McKetta, J. J., Jr., et al.: *Phase Equilibria in Hydrocarbon-Water Systems-I*, 1
McKetta, J. J., Jr., et al.: *Phase Equilibria in Hydrocarbon-Water Systems-II*, 319

M

Mallinger, M. A.: *Some Controlling Factors Regarding Variable Weighting of Cement Slurries* (Tech. Note), Dec. JPT
Maidock, E. S., et al.: *Some Preliminary Investigations of Quantitative Interpretations of Radioactivity Logs*, 19
MicroLog: Electrical logging method for detailed determination of permeable beds, 155
Miller, C. C., et al.: *The Estimation of Permeability and Reservoir Pressure from Bottom Hole Pressure Build-up Characteristics*, 91
Morgan, F., et al.: *Improvements in the X-Ray Saturation Technique of Studying Fluid Flow*, 183

MORISON, J. R., et al.: *The Force Exerted by Surface Waves on Piles*, 149

MORRISON, PAUL W.: *Acidizing Fundamentals* (Art.): Sept. JPT.

MULL, J. B.: *American Oil-Shale Developments* (Art.), May JPT

MUSKAT, MORRIS: *The Effect of Permeability Stratification in Complete Water-Drive Systems*, 349

MUSKAT, MORRIS, et al.: *The Effect on Well Productivity of Formation Penetration Beyond Perforated Casing*, 309

N

NELSON, M. D., et al.: *Lime Content of Drilling Mud - Calculation Method* (Tech. Note), July JPT

NIGRA, JOHN O.: *Associate in Arts in Petroleum Technology: A New Approach to Formalized Training for the Petroleum Industry* (Art.), Jan. JPT

NISLE, R. G., et al.: *An Electronic Analog Computer for Solving the Flash Vaporization Equilibrium Equation*, 143

NUSS, FRANK, et al.: *Ability of Drilling Mud to Lift Bit Cuttings*, 35

O

O'BRIEN, M. P., et al.: *The Force Exerted by Surface Waves on Piles*, 149

Offshore operations: Force exerted by surface waves on piles, 149

P

PAYNODE, H. W., et al.: *The Presence of Conductive Solids in Reservoir Rocks As a Factor in Electric Log Interpretation*, 47

Perforation: Effect on well productivity of formation penetration, 309
Relative productivity of perforated casing, 323

Permeability: Estimation of permeability and reservoir pressure, 91
Effect of permeability stratification in complete water drive systems, 349

Piles: Force exerted by surface waves, 149

POGUE, JOSEPH E., et al.: *Financing Transactions of the Petroleum Industry in 1949* (Art.), Feb. JPT

Pores: Distribution in reservoir rocks, 195
Liquid-liquid displacement as affected by liquid-liquid viscosity ratio and miscibility, 215
Kobe porosimeter and the Oilwell Research porosimeter, 313

Porosity: The Kobe porosimeter and the Oilwell Research porosimeter, 313

PORTER, JOE A., et al.: *Vapor-Liquid Equilibrium Data on the System Natural Gas-Water-Triethylene Glycol at Various Temperatures and Pressures*, 235

Pressure: Estimation of permeability and reservoir pressure from bottom hole pressure build-up characteristics, 91
Coexistence of liquid and vapor phases at pressure above 10,000 psi, 119
Water vapor content of nitrogen-free natural gas saturated at various conditions of temperature and pressure, 241
Vapor-liquid equilibrium data, 235
High pressure water injection, New Hope Field, 325
Bubble point pressures and reservoir volume factors, 345

PURCELL, W. R.: *Interpretation of Capillary Pressure Data* (Tech. Note), Aug. JPT

R

Radioactivity: Some preliminary investigations of quantitative interpretations, 19

REAMER, H. H., et al.: *Volumetric Behavior of Oil and Gas from a Louisiana Field I*, 261

Recovery efficiency: Critical analysis of the effect of well density, 269

REICHERTZ, P. P., et al.: *Pore Size Distribution of Petroleum Reservoir Rocks*, 195

REID, LAURANCE S., et al.: *Vapor-Liquid Equilibrium Data on the System Natural Gas-Water-Triethylene Glycol at Various Temperatures and Pressures*, 235

REID, LAURANCE S., et al.: *The Water Vapor Content of Essentially Nitrogen-Free Natural Gas Saturated at Various Conditions of Temperature and Pressure*, 241

Reservoirs: Performance characteristics of a volumetric condensate reservoir, 83
Study of reservoir performance of the First Grubb Pool, San Miguelito Field, 243
Volumetric Behavior of oil and gas from a Louisiana Field, 261
Performance of limestone reservoirs, 287
Performance of Lower Pawelek Reservoir, Falls City Field, 335

Rocks: Quantitative evaluation of the physical characteristics of reservoir rock from electric log data, 105
Pore size distribution, 195
Analysis of fractured limestone cores, 225
Performance of limestone reservoirs, 287

ROE, R. P., et al.: *Performance Characteristics of a Volumetric Condensate Reservoir*, 83

ROSE, WALTER D., et al: *Anomalies in the Measurement of Wetting Liquid Pressure Gradients* (Tech. Note), June JPT

ROSE, WALTER D., et al.: *Some Theoretical Considerations Related to the Quantitative Evaluation of the Physical Characteristics of Reservoir Rock from Electrical Log Data*, 105

RUSSELL, CHARLES D., et al.: *Relative Permeability to Gas*, 65

RZASA, MICHAEL J., et al.: *Correlation of Bottom Hole Sample Data*, 345

RZASA, MICHAEL J., et al.: *The Coexistence of Liquid and Vapor Phases at Pressure above 10,000 PSI*, 119

S

SP Log: Selective SP logging, 129
The SP log in shaly sands, 205

SAGE, B. H., et al.: *Volumetric Behavior of Oil and Gas from a Louisiana Field I*, 261

San Miguelito Field: Study of reservoir performance of the First Grubb Pool, 243

SCHAAF, S. A., et al.: *The Force Exerted by Surface Waves on Piles*, 149

SHOWALTER, W. E.: *Mounting Core Analysis Specimens in Thermoplastics* (Art.) Dec. JPT

SIMS, W. P., et al.: *Lakeview Pool, Midway-Sunset Field*, 7

STOMOD, ROBERT L.: *Attainment of Connate Water in Long Cores by Dynamic Displacement* (Tech. Note), Mar. JPT

SMITH, R. V.: *Determining Friction Factors for Measuring Productivity of Gas Wells*, 73

Spacing: Critical analysis of the effect of well density on recovery efficiency, 269

SPENCER, J. R.: *High Pressure Mercury Pump* (Tech. Note), Nov. JPT

T

TAYLOR, VERNON, et al.: *1949 — A Year of World-Wide Production Growth* (Art.), May JPT

THOMAS, H. R., et al.: *The Present and Potential LP-Gas Market* (Art.), Oct. JPT

THOMPSON, E. O.: *The Application of the Market Demand Statute to Oil Production in Texas* (Art.), Mar. JPT

THOMPSON, HOWARD, et al.: *Ability of Drilling Mud to Lift Bit Cuttings*, 35

THORNE, W. R., et al.: *The Present and Potential LP-Gas Market* (Art.), Oct. JPT

TRUBE, ALBERT S., JR., et al.: *High Pressure Water Injection for Maintaining Reservoir Pressures, New Hope Field, Franklin County, Texas*, 325

V

Viscosity: Liquid-liquid displacement in porous media, 215

W

Water drive: Effect of permeability stratification in complete water drive systems, 349

Water vapor content: Of nitrogen-free natural gas saturated at various conditions of temperature and pressure, 241

WATKINS, T. E., et al.: *Lime Content of Drilling Mud - Calculation Method* (Tech. Note), July JPT

WATSON, MARSH S., JR., et al.: *Relative Productivity of Perforated Casing - I*, 179

WATSON, MARSH S., JR., et al.: *Relative Productivity of Perforated Casing - II*, 323

WESTMAN, BURTON J.: *Mud Flow Through Oil Field Diamond Core Bits* (Art.), July JPT

WICKENDEN, WILLIAM E.: *The Second Mile* (Art.), Feb. JPT

WILLIAMS, MILTON: *Estimation of Interstitial Water from the Electric Log*, 295

WOODWARD, LOUIS A.: *Aerial Photogrammetry As Applied to the Petroleum Industry* (Art.), Jan. JPT

WYLLIE, M. R. J., et al.: *Some Theoretical Considerations Related to the Quantitative Evaluation of the Physical Characteristics of Reservoir Rock from Electrical Log Data*, 105

WYLLIE, M. R. J., et al.: *The Presence of Conductive Solids in Reservoir Rocks As a Factor in Electric Log Interpretation*, 47

Oil And Gas Developments In Alabama, Georgia and Florida During 1949

By JAMES PROCTOR *

ALABAMA

There were 20 wells completed during 1949 in the State of Alabama, six of which were field wells and 14 were wildcat ventures. Four of the six field wells were completed as producers and all of the wildcats were completed as dry holes, however, as the year closed, the Alamill Oil Corp. No. 1 - A Lewis, located in Marion County was testing gas shows and it is possible that this well might result in the discovery of a gas field.

Geophysical activity decreased during the last half of the year with only one seismograph crew active, whereas, during the first period of the year, there were eight geophysical or core drill crews active.

The amount of acreage under lease remained essentially the same. While large holdings of acreage were surrendered in the northern counties of the State, the renewed leasing interests in the south and southwestern portions offset the acreage that was dropped.

To date all of the oil production in Alabama has been from the Gilbertown and East Gilbertown Fields. The total production for the year 1949 amounted to 464,456 bbl, bringing the cumulative oil production from these fields to 1,927,026 bbl. The Gilbertown Field was discovered during the early part of 1944 and the East Gilbertown Field was discovered during the fall of 1945.

WILDCAT WELLS DRILLED DURING 1949 - ALABAMA

COUNTY	OPERATOR	WELL	COMP. DATE	T. D.	REMARKS
Choctaw	Houser Drlg. Co.	#1 Boney Est.	12-21-49	3,700	D & A Cre U
Choctaw	Keisker Dev. Co.	#1 Robert Locke	7-26-49	3,499	D & A Cre U
Choctaw	Keisker Dev. Co.	#1 Rosenbaum-Dee	10-12-49	4,025	D & A Cre U
Choctaw	Houser Drlg. Co.	#1 Geo. W. Turner	4-24-49	3,568	D & A Cre U
Clarke	A. R. Temple	#1 Scotch Lbr. Co.	8-1-49	5,004	D & A Cre U
Clarke	Humble Oil & Refg.	#1 Bixler	7-10-49	6,070	D & A Cre L
Covington	A. R. Temple	#2 C. S. Williams	4-4-49	4,510	D & A Cre L
Covington	A. R. Temple	#1 Martin Spicer	3-21-49	4,296	D & A Cre L
Escambia	Dan L. Reynolds	#1 St. Regis Paper	12-16-49	6,658	D & A Cre L
Franklin	Ogg & Easton	#1-A Audie Harris	12-9-49	2,999	D & A (?)
Houston	Union Prod. Co.	#1 Kirkland	7-17-49	8,100	D & A Cre L
Pike	Foster & Dunnigan	#1 Folmer	4-30-49	3,513	D & A (?)
Washington	Humble Oil & Refg.	#2 J. R. Williams	2-6-49	15,668	D & A (?)
Washington	Humble Oil & Refg.	#1 C. E. Harrell	7-28-49	8,505	D & A Cre L - OWDD

* GEOLOGIST, MISSISSIPPI STATE OIL AND GAS BOARD.
MANUSCRIPT RECEIVED AT THE OFFICE OF THE INSTITUTE, NOVEMBER, 1950.

FLORIDA

Florida's drilling activity during 1949 totaled 22 wells of which six were field wells in the lone Sunniland Field in Collier County and 16 were wildcats. Three of the six field wells were completed as producers. Geophysical and core drill activity proceeded much the same as for 1948, with one gravity meter crew, one seismograph crew, one magnetometer crew, and one to three core drill crews active during most of the year.

There were no major leasing plays in Florida during the year, however, acreage continued to be acquired by the major companies.

Florida produced 441,720 bbl from the Sunniland Field in 1949 bringing the cumulative production to 1,091,160 bbl.

WILDCAT WELLS DRILLED DURING 1949 - FLORIDA

COUNTY	OPERATOR	WELL	COMP. DATE	T. D.	REMARKS
Collier	Humble Oil & Refg.	#E-1 Gulf Coast Realty	7-27-49	12,210	D & A (?)
Columbia	Sun Oil Co.	#1 Clarence Loyd	7-4-49	2,928	D & A (?)
Columbia	Sun Oil Co.	#1 Ruth Bishop	8-24-49	4,828	D & A (?)
Columbia	Sun Oil Co.	#1 W. F. Johnson	5-31-49	3,051	D & A (?)
Dixie	Sun Oil Co.	#1 P. C. Crapps	3-6-49	5,404	D & A (?)
Jackson	Humble Oil & Refg.	#1 C. W. Tindel	3-16-49	9,243	D & A (?)
Jefferson	Coastal Petr. Co.	#1 E. P. Larsh	1-8-49	7,913	D & A Cre L
Lafayette	Coastal Petr. Co.	#1 Ronald Sapp	3-20-49	3,410	D & A (?)
Levy	Humble Oil & Ref.	#1 C. E. Robinson	8-22-49	4,609	D & A (?)
Marion	Sun Oil Co.	#1 H. T. Parker	4-24-49	3,845	D & A Quzite
Monroe	Coastal Petr. Co.	#1 Staked	9-30-49	7,560	D & A (?)
Putnam	Sun Oil Co.	#1 H. E. Westbery, et al	1-7-49	3,892	D & A (?)
Suwanee	Sun Oil Co.	#1 A. B. Russell	8-2-49	3,140	D & A (?)
Taylor	Gulf Refg. Co.	#1 Brook-Scanlon Co.	11-30-49	5,517	D & A Igneous
Volusia	Grace Drlg. Co.	#1 Retail Lbr. Co.	1-31-49	5,424	D & A (?)

GEORGIA

There were six dry holes drilled in Georgia during 1949, and the state still remains in the non-producing column. A very small amount of core drill and geophysical activity was done in 1949; one core drill crew was active during January, and one magnetometer crew was active for the following three months.

There was almost no leasing activity in Georgia during 1949, however, individual operators built small blocks in some areas.

WILDCAT WELLS DRILLED DURING 1949 - GEORGIA

COUNTY	OPERATOR	WELL	COMP. DATE	T. D.	REMARKS
Brooks	Dan E. Hughes	#1-A E. M. Rodgers, Sr.	4-12-49	3,845	D & A Cre L
Brooks	Dan E. Hughes	#1 E. M. Rodgers, Sr.	3-15-49	138	D & A-J & A
Echols	Humble Oil & Refg.	#1 W. D. Bennett & H. Langdale	9-25-49	4,882	D & A (?)
Houston	Tricon Minerals, Inc.	#1 H. B. Gilbert	9-25-49	1,699	D & A Granite
Houston	Tricon Minerals, Inc.	#1 J. D. Duke	9-5-49	1,405	D & A Granite
Seminole	Mont Warren	#1 W. E. Harlow Est.	2-28-49	3,554	D & A (?)

Oil And Gas Developments In Mississippi During 1949

By H. M. MORSE * and JAMES PROCTOR *

During the year ending December 31, 1949, Mississippi, one of the nation's younger producing states broke into ninth place among the various states in oil production, and from the reserves that she has proven, stands approximately seventh in the nation. Mississippi celebrated her tenth anniversary in the oil business with the discovery of eight new fields and two new reservoirs to add to her productive capacity.

Mississippi has lacked the impetus of having relatively shallow production, only one small field has production above 4500 feet, and three of her major fields are below 10,000 feet deep. Ten of her 36 active fields on December 31, 1949 had only one producible well, and six of the remainder of the fields had five wells or less. Therefore, Mississippi has had a relatively slow productive growth, because of the depths involved and the small size of many of her proven fields. However, drilling is relatively easy and inexpensive; and there are vast areas in Mississippi which are still unexplored-Mississippi has a rosy future.

PRODUCTION

Production for 1949 was 37,855,120 barrels of oil and condensate from 36 fields and 50 oil or gas reservoirs, this was a decrease of approximately 8,000,000 barrels compared with 1948. This decrease in production was brought about primarily by the severe cuts in the purchases of crude oil from low gravity oil fields, and also due in part to a further reduction in production by the establishment of allowables in several of the fields by the State Oil and Gas Board. The approximate reduction in the daily rate of oil production due to pipeline restrictions amounted to approximately 20,000 barrels per day, while the reduction due to the setting of field allowables in a number of the oil fields in the State amounted to approximately 11,000 barrels daily.

Gas production during the year amounted to 108,978,452 MCF which was an increase of approximately 19,000,000 MCF over the previous year. This increase was due primarily to the establishment of gas outlets from several of the fields that did not previously have pipeline connections.

Approximately 35,000,000 MCF of gas was re-injected in to the producing horizons in the Brookhaven and Cranfield Fields which are the two field-wide unitization operations now in effect in Mississippi.

DRILLING

In 1949, 349 wells were drilled for oil or gas compared to 426 wells drilled in 1948. The decrease in the number of wells drilled was due to a lessening in field development drilling, the wildcat drilling activity being essentially the same as for the previous year. In the drilling of 112 wildcats, 8 new oil or gas fields were discovered and 4 piercement type salt domes were confirmed by the drill. In addition to extending fields, the development drilling established two new producing horizons in proven fields.

Mississippi operators drilled a total of 2,427,124 feet of hole, of which 1,634,728 feet were in field development drilling, and 792,446 feet were drilled in wildcat wells. The average field well depth during 1949 was 6672 and the average wildcat well was 7075 feet deep. Mississippi's percentage of wildcat discoveries rose to 7.8% which is better than in any previous year.

DISCOVERIES

New oil fields were the Armstrong Field, Adams County; Bude Field, Franklin County; Hartman Field, Lincoln County; Possum Corner Field, Wilkinson County; Bassum Field; Jefferson County; and Sand Hill Field, Greene County. New gas fields were the Rodney Field, Jefferson County and the Sharon Field, Jones County. Wilcox production was established in the Oldenburg Field in Franklin County, and a deeper producing horizon was extended across the fault in Tinsley Field in Yazoo County. The four piercement type salt domes confirmed by drilling were the Carmichael, Oakley and Learned Domes in Hinds County and the Centerville Dome in Jones County.

PRODUCIBLE WELLS

There were 237 field wells drilled in 1949, 179 of which were completed as producers, and 58 as dry holes. Producible wells at the end of the year totaled 1,555, an increase of 156 wells over the previous year. There were a number of wells in the Tinsley, Pickens, Mallieu and LaGrange Fields which were abandoned during the year after proving to no longer be commercial producers.

LEASING

The leasing activity in the State was slow as compared with the years preceding, however, several blocks were taken during the year, mostly in the southern and central portions and one block was assembled in the northern portion of the State. The acreage under lease remained essentially the same.

* H. M. MORSE, SUPERVISOR, MISSISSIPPI STATE OIL AND GAS BOARD.
* JAMES PROCTOR, GEOLOGIST, MISSISSIPPI STATE OIL AND GAS BOARD.
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TABLE I - OIL AND GAS PRODUCTION STATISTICS FOR MISSISSIPPI DURING 1949

LINE NUMBER	FIELD (County)*	PRODUCING FORMATION NAME AND AGE	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO cf/BBL	CONDENSATE PRODUCTION (Thousands of Bbl)	
				AREA PROVED ACRES	BARRELS TO END OF 1949	BARRELS DURING 1949	AREA PROVED ACRES	MILLION CU FT TO END OF 1949	MILLION CU FT DURING 1949		TO END OF 1949	DURING 1949
1	Amory - *Monroe*	Hartselle, Mis	1926		Abandoned	12-31-37	200	1,717		Dry Gas		
2	Amsterdam - *Adams*	Wilcox, Eoc	1949	160	57,624	57,624		11	11	200(Est)		
3	Baxterville - *Lamar & Marion*	Eutaw-L.Tuscaloosa, Cren	1945				6,480	10,935	3,752	141,666	82,303	29,642
4	Baxterville - *Lamar & Marion*	L.Tuscaloosa, Cren	1944	5,040	16,156,916	2,337,204		6,551	990	380		
5	Brookhaven - *Lincoln*	L.Tuscaloosa, Cren	1943	6,830	15,874,583	5,238,225		Gas Re-Injected		560		
6	Brunsburg - *Claiborne*	Cockfield, Eoc	1944				320	33	0	Dry Gas		
7	Bude - *Franklin*	L.Tuscaloosa, Cren	1949	160	219,355	219,355		296	296	1,422		
8	Carthage Point - *Adams*	L.Tuscaloosa, Cren	1945				3,840	19,560	5,982	13,230	1,585,193	460,837
9	Cary - *Sharkey*	Selma Gas Rock, Cren	1941	160	59,324	Abandoned: 8-17-46		10		172		
10	Cranfield - *Adams & Franklin*	Wilcox - Eoc	1943	1,000	3,200,656	860,200		716	197	208		
11	Cranfield - *Adams & Franklin*	L.Tuscaloosa, Cren	1944	3,240	20,770,459	4,609,456	x	Gas Re-Injected		6,855	Included as Oil	
12	Cranfield - *Adams & Franklin*	Paluxy, Cret	1946				320	3,123	1,525	Dry Gas		
13	Pucutta - East - *Wayne*	Eutaw, Cren	1943	3,960	10,134,733	1,407,088		554	80	54		
14	Pucutta - West - *Wayne*	Eutaw, Cren	1946	1,000	1,882,246	435,284		123	40	51		
15	Fayette - *Jefferson*	Wilcox, Eoc	1946				960	298	180	Dry Gas		
16	Fayette - *Jefferson*	L.Tuscaloosa, Cren	1945	320	716,003	186,345		1,680	405	2,553		
17	Flora - *Madison*	Selma Gas Rock, Cren	1943	160	84,331	11,131		7	0.6	50(Est)		
18	Gainsville-*Jeff Davis & Simpson*	Eutaw-L.Tuscaloosa, Cren	1944				23,040	102,111	43,673	126,050	783,415	320,734
19	Gainsville-*Jeff Davis & Simpson*	L.Tuscaloosa, Cren	1945	40	225,812	5,828		1,203	392	34,100		
20	Gainsville-*Jeff Davis & Simpson*	L.Tuscaloosa, Cren	1944	80	213,380	31,542		2,827	396	61,824		
21	Heidelberg-- East - *Jasper*	Eutaw-L.Tuscaloosa, Cren	1944	4,200	15,121,151	1,692,714		1,346	134	79		
22	Heidelberg - West - *Jasper*	Eutaw-L.Tuscaloosa, Cren	1944	2,400	6,334,736	1,046,262		563	77	88		
23	Hub - *Marion*	Eutaw - Cren	1946				640	928	879	34,583	26,594	24,133
24	Hub - *Marion*	L.Tuscaloosa - Cren	1945	1,590	728,065	246,262		2,625	772	2,408	Included as Oil	
25	Hub - *Marion*	Comanche - Cret	1946				320	253	5	43,000	7,124	50
26	Jackson - *Hinds & Rankin*	Selma Gas Rock - Cren	1930				7,500	116,722	289	Dry Gas		
27	Kings - *Warren*	Zilpha - Eoc	1946				320	58	0	Dry Gas		
28	Lakeview - *Adams*	Wilcox - Eoc	1946	5,040	7,831,421	3,967,373		1,536	780	200(Est)		
29	Lakeview - *Adams*	L.Tuscaloosa - Cren	1946	80	4,508	Abandoned: 7-17-46		10		4,000(Est)		
30	South La Grange - *Adams*	Wilcox - Eoc	1948	800	654,866	618,738		134	126	200(Est)		
31	Langsdale - *Clarke*	Eutaw - Cren	1944	990	1,464,364	308,047		49	16	49		
32	Wallalieu - *Lincoln*	L.Tuscaloosa - Cren	1944	3,960	13,859,125	5,327,594		4,662	1,766	347		
33	McBride - *Jefferson*	Cockfield - Eoc	1947		0	0	320	0	0	Sour Gas		
34	Oldenburg - *Franklin*	Wilcox - Eoc	1949	120	51,732	51,732		8	8	200(Est)		
35	Oldenburg - *Franklin*	L.Tuscaloosa - Cren	1947	120	19,497	2,657		17	2	1,000		
36	Ovett - *Jones*	Glen Rose & Paluxy, Cret	1948	40	49,180	14,512		12	3	230		
37	Pickens - *Madison & Yazoo*	Eutaw, Cren	1940	2,200	12,350,770	1,111,187		1,291	94	87		
38	Pine Ridge - *Adams*	Wilcox, Eoc	1946	440	623,932	403,595		149	96	246		
39	Possum Corner - *Wilkinson*	Wilcox, Eoc	1949	40	496	496		9	9	16,667		
40	Quitman - *Clarke*	Eutaw - Cren	1945	40	2,490	Abandoned: 7-1-49		0.08	0	21		
41	Rodney - *Jefferson*	L.Tuscaloosa, Cren	1949				320	7	7	18,225	450	450
42	Roxie - *Franklin*	L.Tuscaloosa, Cren	1948	120	43,648	43,648		233	233	14,094	Included in Oil	
43	Russum - *Jefferson*	L.Tuscaloosa, Cren	1949	40	2,746	2,746		3	3	1,000		
44	Sandersville - *Jones*	Eutaw - Cren	1947	80	882	Abandoned: 11-27-46			0	x		
45	Sand Hill - *Greene*	L.Tuscaloosa, Cren	1949	40	4,098	4,098		0.2	0.2	50		
46	Sandy Hook - *Marion*	L.Tuscaloosa, Cren	1948				1,280	126	87	50,358	2,664	2,039
47	Sharon - *Jones & Jasper*	Eutaw, Cren	1949				320	0	0	299,000	0	0
48	Soso, *Jones, Jasper, & Smith*	Eutaw, Cren	1945				4,800	12,176	6,421	35,900	320,828	161,190
49	Tinsley, *Yazoo*	Selma, Eutaw, & Tuscaloosa, Cren	1939	9,748	112,595,635	5,568,681		4,592	239	75		
50	Yellow Creek - *East, Wayne*	Eutaw, Cren	1948	240	103,833	79,511		6	5	57		
51	Yellow Creek - *West, Wayne*	Eutaw, Cren	1947	2,640	1,667,453	886,940		94	44	56		
52	TOTALS			57,158	245,918,405**	37,855,130**	50,980	399,449	108,978			

*The four wells in Brookhaven Field and the six wells in Cranfield Field (L. Tuscaloosa) shown as gas wells are being used as gas injection wells for pressure maintainence.

**Includes condensate which is considered as oil in this report.

LINE NUMBER	NUMBER OF WELLS[c]			WELLS PRODUCING[f] DEC. 1949			RESERVOIR PRESSURE LB PER SQ INCH		SECONDARY RECOVERY[g]	CHARACTER OF OIL[h]		PRODUCING FORMATION					DEEPEST ZONE TESTED[n] TO END OF 1949	
	COMPLETED TO END 1949	1949		OIL		GAS	INITIAL	AVG. / END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[i]	POROSITY PER CENT	DEPTH TO TOP OF PRODUCING ZONE FT.[k]	PROD. THICKNESS AVG. FT. NET	STRUCTURE[p]	NAME	DEPTH OF HOLE - FT.
		COMPLETED	ABANDONED	FLOWING	ARTIFICIAL LIFT													
1	3	0	0			0	680			Dry Gas	x		x	2,404	14	x	Misl.	3,795
2	4	4	0	2	2	0	2,816	2,721		38	x	S	25	5,445	5	N	Paluxy, Cret	11,212
3	21	8	0			21	3,567	3,447		53	0	S	26	7,614	32	D F	Washita, Cret	10,518
4	126	11	0	85	41		4,022	4,002		16	2.7	S	24.4	8,600	41	D F	Washita, Cret	10,518
5	152	4	0	37	110	4*	4,600	2,823	G C	27-37	0.6	S	26	10,136	36	A F	Paluxy, Cret	12,843
6	1	0	0	0	0	1	400	x		Dry Gas	x	S	25	935	10	D S	Salt	5,646
7	4	4	0	4	0	0	5,100	x		43	x	S	x	11,090	12	x	Paluxy, Cret	11,384
8	12	2	0	0	0	12	4,835	4,266		54	0.02	S	30	10,198	23	A	Paluxy, Cret	12,149
9	4	0	0	0	0	0	x	x		25	x	S	30	3,255	5	D	Cotton Valley, Jur	8,545
10	25	3	0	12	13		2,543	2,390		40	x	S	29	5,740	7	A F	Paluxy, Cret	12,400
11	81	3	1	67	7	6*	4,696	4,377	G C	40	0.13	S	25.5	10,042		A F	Paluxy, Cret	12,400
12	1	0	0	0	0	1	5,440	5,325		Dry Gas	x	S	14.2	11,722	18	A F	Paluxy, Cret	12,400
13	100	1	1	0	99	0	2,068	991		22	0	S	29	4,884	29	D F	Comanchean, Cret	11,055
14	25	1	0	0	25	0	2,264	1,689		33	0	S	31	5,088	23	D F	Comanchean, Cret	7,333
15	3	0	0	0	0	3	1,591	1,535		Dry Gas	x	S	x	3,537	7	A	Comanchean, Cret	11,299
16	8	0	0	8	0	0	4,451	3,666		40	0.09	S	29	9,617	27	A	Comanchean, Cret	11,299
17	5	0	0	0	4	0	x	x		26	1.0	S	30	4,337	5	A	Comanchean, Cret	10,211
18	72	2	0	0	0	72	3,660	3,341		52	0.15	S	26	7,734	35	D F	Comanchean, Cret	12,629
19	3	0	0	1	0	0	3,750	3,735		40	x	S	24	8,570	8	D F	Comanchean, Cret	12,629
20	2	0	0	2	0	0	4,070	4,030		42	x	S	31	9,216	10	D F	Comanchean, Cret	12,629
21	107	9	0	86	17	0	2,133	1,991		22	3.25	S	30	4,509	49	D F	Salt	11,724
22																		
23	61	4	0	0	60	0	2,100	1,161		23	3.25	S	28	4,470	36	D F	Salt	11,724
23	2	0	0	0	0	2	3,760	3,714		56	x	S	x	7,965	12	D F	Comanchean, Cret	10,598
24	18	4	0	13	2	3	4,637	4,186		32-51	0.71	S	26	9,030	5	D F	Comanchean, Cret	10,598
25	1	0	0	0	0	1	4,640	4,640		53	x	S	x	10,098	8	D F	Comanchean, Cret	10,598
26	155	0	2	0	0	13	990	x		Dry Gas	x	S	x	2,390	5	A	Altered Igneous	5,530
27	1	0	0	0	0	1	x	x		Dry Gas	x	S	25	1,912	7	D S	Salt	2,433
28	120	19	1	19	97	0	2,712	1,850		41	x	S	28	6,128	6	A	Comanche, Cret	10,675
29	1	0	0	0	0	0	x	x		46	x	S	x	10,537	12	A N	Comanche, Cret	10,675
30	23	18	0	21	2	0	2,739	2,367		42	x	S	28	6,357	5	A N	Porters Creek, Eoc	7,819
31	33	1	0	0	33	0	x	x		19	4.1	S	25	3,535	27	M F	Comanche, Cret	5,620
32	108	14	2	40	59	0	4,684	2,994		38	1.26	S	29	10,366	30	A	Comanche, Cret	11,700
33	1	0	0	0	0	1	x	x		Sour Gas	x	S	x	1,452	10	D S	Salt	2,232
34	3	1	0	1	2	0	x	x		35	x	S	x	5,910	7	N	Comanche, Cret	10,708
35	3	3	0	3	0	0	x	x		37	x	S	x	10,538	2	x	Comanche, Cret	10,708
36	1	0	0	0	1	0	x	x		31	x	S	13.7	12,011	x	D S	Salt	13,355
37	50	0	8	0	42	0	2,000	680		40	0.69	S	28	4,863	16	A F	Eagle Mills	12,250
38	11	3	0	6	5	0	2,493	2,254		41	0.11	S	28	5,544	5	N	Comanchean, Cret	10,514
39	1	1	0	1	0	0	x	x		30	x	S	33	5,083	6	N	Comanchean, Cret	11,345
40	1	0	1	0	0	0	x	x		15	x	S	x	3,658	3	M F	L. Tuscaloosa, Cret	4,775
41	1	1	0	0	0	1	x	x		58	x	S	19.4	9,409	4	A	L. Tuscaloosa, Cret	9,457
42	3	2	0	3	0	0	x	x		39-51	x	S	30	10,578	6	D	L. Tuscaloosa, Cret	10,929
43	1	1	0	0	1	0	x	x		38	x	S	x	9,746	13	x	L. Tuscaloosa, Cret	9,952
44	2	0	0	0	0	0	x	x		11	x	S	x	5,450	5	D F	L. Tuscaloosa, Cret	7,280
45	1	1	0	0	1	0	x	x		25	x	S	x	7,804	8	D F	L. Tuscaloosa, Cret	8,503
46	4	1	0	0	0	4	4,134	4,061		53	x	S	28	8,979	14	D F	Comanchean, Cret	10,991
47	1	1	0	0	0	1	x	x		58	x	S	29	5,505	34	M F	Comanchean, Cret	8,215
48	15	4	0	0	0	15	2,959	2,598		65	0.02	S	29	6,448	11	A	Comanchean, Cret	8,151
49	354	4	6	0	284	0	2,020	x		29-47	0.67	S	27	4,455	20	A F	Smackover - Jur	11,625
50	6	3	0	0	6	0	x	x		19	x	S	29	4,782	27	D F	L. Tuscaloosa, Cret	5,546
51	66	31	0	0	66	0	2,025	1,223		19	x	S	29	4,782	38	D F	Comanchean, Cret	8,512
52		179	20	414	979	162*												

TABLE 2 - SUMMARY OF DRILLING OPERATIONS IN MISSISSIPPI DURING 1949

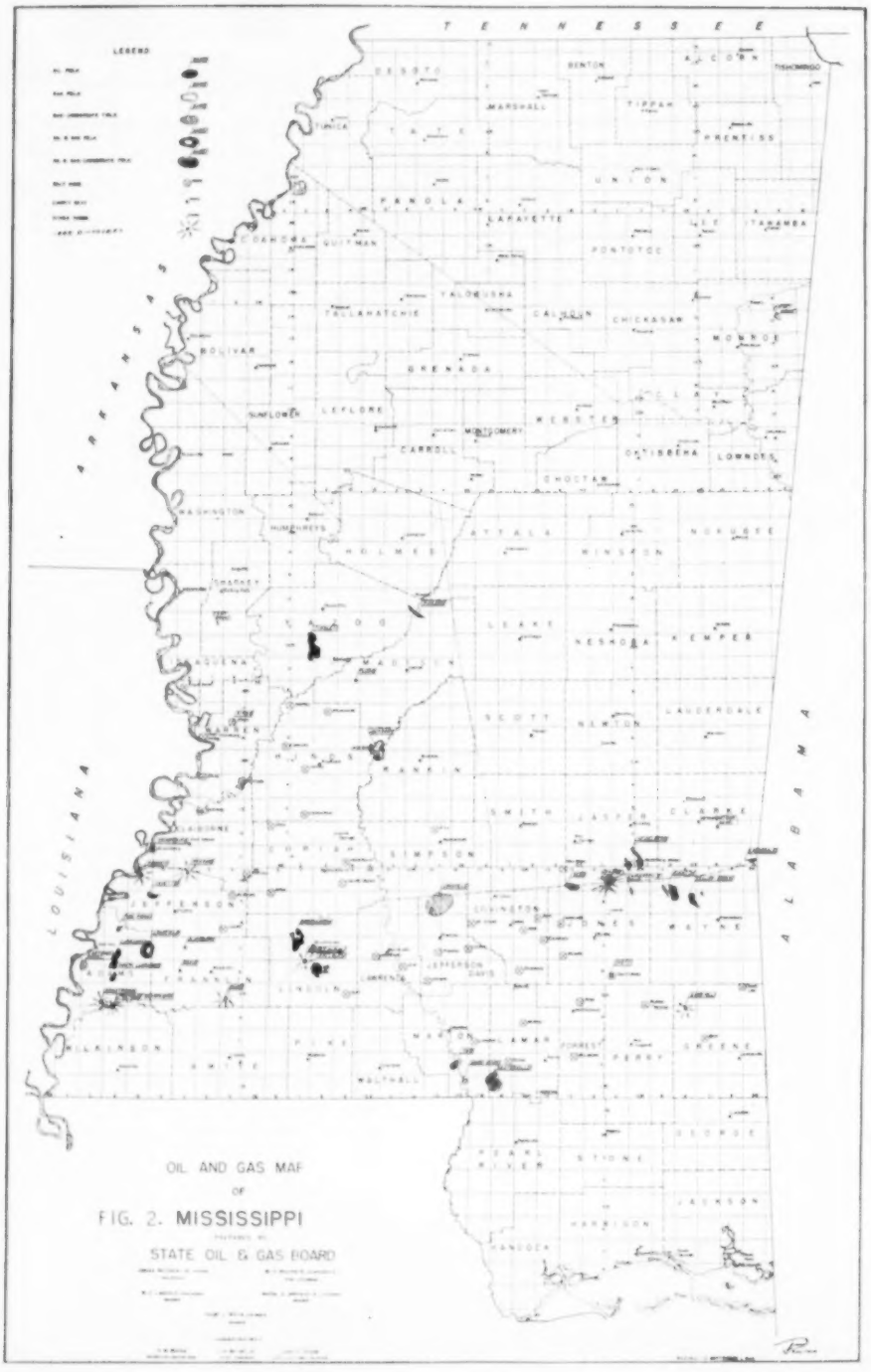
IMPORTANT WILDCATS DRILLED IN 1949

LINE NUMBER	COUNTY	LOCATION SEC.	LOCATION TWP.	LOCATION RGE.	TOTAL DEPTH, FT.	SURFACE FORMATION	DEEPEST HORIZON TESTED	DRILLED BY	INITIAL PRODUCTION PER DAY OIL, U.S. BBL.	INITIAL PRODUCTION PER DAY GAS, MCF	INITIAL PRODUCTION PER DAY CONDENSATE U.S. BBL.	CHOKE FRACTIONS OF AN INCH	PRESSURE, LB. PER SQ. IN. CASING	PRESSURE, LB. PER SQ. IN. TUBING	REMARKS (NOTE DRY HOLES HERE)
1	Adams	12	7 N	1 W	7,005	Recent	Wilcox, Exc	Harris Mallow							D & A
2	Adams	12	7 N	2 W	6,925	Recent	Wilcox, Exc	Harris Mallow							D & A
3	Adams	15	7 N	1 W	6,050	Recent	Wilcox, Exc	H. Barksdale Brown							D & A
4	Adams	10	7 N	1 W	6,521	Recent	Wilcox, Exc	Claypool & Harrison							D & A
5	Adams	32	9 N	2 W	7,210	Recent	Wilcox, Exc	Danciger O & R							D & A
6	Adams	17	6 N	3 W	6,714	Recent	Wilcox, Exc	Daryl Davis-Big Chief							D & A
7	Adams	28	6 N	3 W	6,620	Recent	Wilcox, Exc	Elliott-Kemp							D & A
8	Adams	42	6 N	1 W	7,005	Pascagoula-Mio	Wilcox, Exc	Gholson-Smith							D & A
9	Adams	3	5 N	2 W	6,615	Recent	Wilcox, Exc	James E. Kemp							D & A
10	Adams	55	8 N	1 W	6,006	Recent	Wilcox, Exc	James E. Kemp							D & A
11	Adams	25	6 N	3 W	6,640	Recent	Wilcox, Exc	Kemp-Elliott							D & A
12	Adams	29	6 N	2 W	7,029	Recent	Wilcox, Exc	Latmer-Lewis-Red Wing							D & A
13	Adams	3	6 N	2 W	6,510	Recent	Wilcox, Exc	Latmer-Red Wing							D & A
14	Adams	46	6 N	2 W	7,016	Recent	Wilcox, Exc	L.M. Lockhart							D & A
15	Adams	22	5 N	2 W	6,675	Pascagoula-Mio	Wilcox, Exc	Dan Reynolds							D & A
16	Adams	1	5 N	2 W	11,211	Recent	L.Tuscaloosa, Creu	Roeser & Pendleton							D & A
17	Adams	2	6 N	3 W	6,624	Recent	Wilcox, Exc	C.W. Sharp							D & A
18	Adams	18	8 N	3 W	6,510	Recent	Wilcox, Exc	Sohio Petr							D & A
19	Adams	55	7 N	3 W	6,510	Recent	Wilcox, Exc	Sohio-Kemp							D & A
20	Adams	36	5 N	3 W	6,520	Pascagoula-Mio	Wilcox, Exc	Sohio-Jones-Kemp	F 360			32/64		665	Disc.Armstrong Field
21	Carroll	2	17 N	3 E	3,560	Sparta-Eoc	Eutaw, Creu	H. Barksdale Brown							D & A
22	Clarke	31	3 N	17 E	4,900	Tallahatta-Eoc	L.Tuscaloosa, Creu	C.Porter Johnson							D & A
23	Clarke	16	2 N	14 E	5,767	Cook Mtn - Eoc	Cret	Dan Reynolds							D & A
24	Copiah	20	4 N	4 E	10,341	Catahoula-Mio	Cret	Amerada Petr							D & A
25	Covington	22	8 N	16 W	9,610	Catahoula, Mio	L.Tuscaloosa, Creu	Helmerich & Payne							D & A
26	Forrest	4	4 N	12 W	9,417	Catahoula-Mio	Cret	Humble O & R							D & A
27	Forrest	26	1 S	13 W	8,860	Catahoula, Mio	Cret	Morgan & Norton							D & A
28	Franklin	29	5 N	4 E	11,308	Pascagoula-Mio	Tuscaloosa,Creu	Barnsdall Oil	F 356			11/64		2,150	Disc.Bude Field
29	Franklin	3	7 N	2 E	6,513	Pascagoula-Mio	Wilcox, Exc	R.A. Campbell							D & A
30	Franklin	27	6 N	4 E	11,026	Pascagoula-Mio	Cret	L.M. Lockhart							D & A
31	Franklin	44	6 N	2 E	11,042	Pascagoula-Mio	L.Tuscaloosa, Creu	L.M. Lockhart							D & A
32	Franklin	34	7 N	2 E	6,215	Pascagoula-Mio	Wilcox, Exc	Wilbom Prod							D & A
33	Franklin	8	5 N	1 E	7,005	Pascagoula-Mio	Wilcox, Exc	Barnett Serio							D & A
34	Franklin	27	6 N	3 E	10,938	Pascagoula-Mio	Cret	Vaughey & Vaughey							D & A
35	George	3	2 S	7 W	8,506	Pascagoula-Mio	Cret	Hunt Oil Co							D & A
36	Greene	16	5 N	8 W	8,500	Pascagoula-Mio	Cret	Humble O & R							D & A
37	Greene	6	4 N	8 W	8,530	Pascagoula-Mio	L.Tuscaloosa, Creu	Humble O & R							D & A
38	Greene	3	4 N	8 W	8,903	Pascagoula-Mio	L.Tuscaloosa, Creu	Humble O & R	P 46						Disc.Sand Hill Field
39	Greene	35	3 N	6 W	9,018	Pascagoula-Mio	Cret	Morgan & Norton							D & A
40	Greene	23	4 N	8 W	8,445	Pascagoula-Mio	L.Tuscaloosa, Creu	Dan Reese							D & A
41	Grenada	13	22 N	3 E	3,301	Recent	Tuscaloosa,Creu	Geo.S. Eagle							D & A
42	Harrison	20	5 S	13 W	7,892	Citronelle-Pli	Cret	Hunt Oil Co							D & A
43	Hinds	2	6 N	1 E	4,750	Jackson-Eoc	Tuscaloosa,Creu	Shell Oil							D & A
44	Hinds	2	6 N	1 E	3,995	Jackson-Eoc	Tuscaloosa,Creu	Shell Oil							D & A
45	Hinds	8	6 N	1 W	4,410	Jackson-Eoc	Eutaw, Creu	Shell Oil							D & A
46	Hinds	27	3 N	3 W	3,254	Catahoula-Mio	Salt	Southeastern Drlg							Disc.Carmichael Dome
47	Hinds	27	5 N	3 W	2,634	Catahoula-Mio	Salt	Sun Oil							Disc. Oakley Dome
48	Hinds	35	5 N	6 W	4,452	Catahoula-Mio	Salt	Texas Co							Disc. Learned Dome
49	Hinds	25	5 N	3 W	3,010	Catahoula-Mio	Wilcox, Exc	Thompson-Morrison							D & A
50	Holmes	8	12 N	3 E	6,313	Cockfield, Eoc	Cret	Vester Williams							D & A
51	Humphreys	13	14 N	4 W	5,008	Recent	Cret	Claypool-Creighton							D & A
52	Issaquena	9	11 N	8 W	8,171	Recent	Vicksburg, Mio	S.C. Oil Group							D & A
53	Itawamba	14	10 S	9 E	1,761	Eutaw, Creu	Mis	Itawamba Assoc							D & A
54	Itawamba	16	11 S	9 E	2,600	Eutaw, Creu	Sil	Magnolia Petr							D & A
55	Jasper	34	4 N	12 E	6,288	Jackson, Eoc	Cret	C.Porter Johnson							D & A
56	Jasper	18	2 N	12 E	5,526	Vicksburg, Olig	Tuscaloosa,Creu	Red Wing Drlg							D & A
57	Jefferson	35	8 N	1 W	6,306	Recent	Wilcox, Exc	H.Barksdale Brown							D & A
58	Jefferson	35	8 N	1 W	6,320	Recent	Wilcox, Exc	H.Barksdale Brown							D & A
59	Jefferson	35	8 N	2 E	10,716	Recent	Cret	William Helis							D & A
60	Jefferson	40	8 N	1 W	6,510	Recent	Wilcox-Exc	L.M. Lockhart							D & A
61	Jefferson	10	8 N	2 E	10,471	Recent	Cret	Southern Oil Corp							D & A
62	Jefferson	17	10 N	2 E	9,952	Recent	L.Tuscaloosa, Creu	Stanolind	P 35				1,300	0	Disc.Russum Field
63	Jefferson	18	10 N	1 W	9,457	Recent	L.Tuscaloosa, Creu	Danciger O & R		F 875	62	11/64		1,275	Disc.Rodney Field
64	Jefferson Davis	16	6 N	16 W	9,726	Citronelle,Plio	Cret	Cities Service							D & A
65	Jones	32	10 N	11 W	7,510	Catahoula, Mio	Cret	Danciger O & R							D & A
66	Jones	28	9 N	11 W	6,676	Catahoula, Mio	Tuscaloosa,Creu	Forest-Honolulu							D & A
67	Jones	5	9 N	11 W	7,737	Catahoula, Mio	Cret.Johnston	E.C. Johnston							D & A
68	Jones	32	10 N	11 W	6,952	Catahoula, Mio	Tuscaloosa,Creu	Red Wing Drlg		F 1,175	65	10/64		2,000	Disc. Sharon Field
69	Jones	18	8 N	13 W	2,068	Pascagoula, Mio	Salt	Walter Sustrunk							Disc.Centerville Dome
70	Jones	27	10 N	11 W	8,215	Catahoula, Mio	Cret	Sunnyland Contr							D & A
71	Lamar	22	5 N	16 W	9,711	Pascagoula, Mio	L.Tuscaloosa, Creu	Honolulu Oil							D & A
72	Lamar	4	3 N	16 W	9,784	Pascagoula, Mio	Cret	Sun Oil							D & A

IMPORTANT WILDCATS DRILLED IN 1949

LINE NUMBER	COUNTY	LOCATION SEC.	TWP.	RGE.	TOTAL DEPTH, FT.	SURFACE FORMATION	DEEPEST HORIZON TESTED	DRILLED BY	INITIAL PRODUCTION PER DAY OIL, U.S. BBL.	GAS MCF	CONDENSATE U.S. BBL.	CHOKE FRACTIONS OF AN INCH	PRESSURE LB. PER SQ. IN. CASING	TUBING	REMARKS (NOTE DRY HOLES HERE)
73	Lamar	30	3 N	16 W	8,046	Pascagoula, Mio	Eutaw, Creu	Union Producing							D & A
74	Lawrence	4	6 N	11 E	10,240	Pascagoula, Mio	Cret	Danciger O & R							D & A
75	Lawrence	22	8 N	10 E	10,950	Citronelle, Pli	Cret	Humble O & R							D & A
76	Lincoln	2	6 N	7 E	19,660	Citronelle, Pli	L.Tuscaloosa, Creu	Big Chief Drlg	F 150						Disc.Hartman Field
77	Madison	35	11 N	4 E	4,955	Cockfield, Eoc	Eutaw, Creu	Brosseo Corp							D & A
78	Madison	22	10 N	4 E	4,990	Cockfield, Eoc	Eutaw, Creu	R.L. Lawrence							D & A
79	Madison	18	11 N	4 E	5,065	Cockfield, Eoc	Eutaw, Creu	Tip Ray, etal							D & A
80	Madison	14	9 N	1 W	6,160	Recent	Eutaw, Creu	Don Reese							D & A
81	Madison	34	7 N	1 E	4,354	Jackson, Eoc	Eutaw, Creu	Shell Oil							D & A
82	Marion	31	5 N	18 W	11,180	Pascagoula, Mio	Cret	Honolulu Oil							D & A
83	Noxubee	21	15 N	19 E	5,015	Mooreville, Creu	Paleozoics	Homer Price							D & A
84	Noxubee	6	13 N	17 E	2,077	Porters Creek,Eoc	L.Tusc. Creu	H.Schmidt,Sims,Weld							D & A
85	Perry	1	1 S	9 W	8,796	Pascagoula, Mio	L.Tusc. Creu	Hunt Oil							D & A
86	Perry	22	1 S	9 W	8,537	Citronelle, Plio	L.Tusc Creu	Hunt Oil							D & A
87	Pike	16	3 N	9 E	11,050	Citronelle, Plio	Cret	Sells Petr							D & A
88	Pike	4	4 N	7 E	11,172	Citronelle, Plio	Cret	Sells Petr							D & A
89	Rankin	21	6 N	2 E	4,215	Jackson, Eoc	Tuscaloosa, Creu	Tip Ray							D & A
90	Rankin	10	5 N	2 E	4,100	Jackson, Eoc	Tuscaloosa, Creu	Shell Oil							D & A
91	Rankin	9	5 N	2 E	4,255	Jackson, Eoc	Tuscaloosa, Creu	Shell Oil							D & A
92	Scott	2	5 N	6 E	6,115	Forrest Hill,Olig	Tuscaloosa, Creu	Carter Oil							D & A
93	Scott	15	8 N	6 E	7,122	Jackson, Eoc	Cret	Continental Oil							D & A
94	Sharkey	14	14 N	7 W	3,970	Recent	Cret	Amerada Petr							D & A
95	Sharkey	31	14 N	5 W	3,803	Recent	Cret	Clyde Creighton							D & A
96	Sharkey	7	11 N	7 W	3,493	Recent	Cret	Halbouty & Blalock							D & A
97	Sharkey	7	10 N	7 W	3,809	Recent	Selma Gas Rock, Creu	Halbouty-Blalock							D & A
98	Smith	11	10 N	14 W	8,503	Catahoula, Mio	Cret	Carter Oil							D & A
99	Smith	26	3 N	8 E	7,506	Vicksburg, Olig	Tuscaloosa, Creu	Martin Harris Drlg							D & A
100	Walthall	2	3 N	11 E	10,453	Citronelle, Plio	Cret	California Co							D & A
101	Walthall	17	1 N	11 E	10,649	Citronelle, Plio	Cret	Sells Petr							D & A
102	Warren	26	17 N	4 E	4,935	Recent	Porters Creek,Eoc	C.Porter Johnson							D & A
103	Washington	31	16 N	7 W	4,158	Recent	Strat Test	Murphy-Sun							D & A
104	Washington	14	15 N	7 W	7,593	Recent	Strat Test	Murphy-Sun							D & A
105	Wayne	29	7 S	7 W	8,463	Catahoula, Mio	L.Tuscaloosa,Creu	Humble O & R							D & A
106	Wayne	1	8 N	6 W	6,300	Vicksburg, Olig	L.Tuscaloosa,Creu	J.W. O'Brien							D & A
107	Wayne	24	9 N	6 W	5,010	Vicksburg, Olig	Eutaw, Creu	Sistrunk-Harris-Payne							D & A
108	Wilkinson	31	4 N	2 W	11,791	Pascagoula, Mio	Cret	American Republics							D & A
109	Wilkinson	5	4 N	2 W	8,307	Pascagoula, Mio	Wilcox, Eoc	Danciger O & R	IP 36	625		11/64		1,275	Disc.Possum Corner Field
110	Wilkinson	35	3 N	1 E	8,020	Pascagoula, Mio	Wilcox, Eoc	Don Reese							D & A
111	Wilkinson	31	4 N	3 W	7,028	Pascagoula, Mio	Wilcox, Eoc	J.D. Reese							D & A
112	Yazoo	36	13 N	2 W	7,005	Recent	Cret	Preible-Thomas							D & A

	In Proven Fields	Wildcats
Number of wells drilling Dec. 31, 1949	18	10
Number of wells completed during 1949 (Oil)	160	6
Number of gas wells completed during 1949	19	2
Number of dry holes completed during 1949	58	104


T E N N E S S E E
LEGEND
DESOTO
MARSHALL
TIPPAH
ALCORN
PRENTISS
UNION
PANOLA
LAFAYETTE
TATE
TUNICA
COAHOMA
QUITMAN
PONTOTOC
TALLAHATCHIE
YALOBUSHA
CALHOUN
CHICKASAW
MONROE
BOLIVAR
GRENADA
SUNFLOWER
LEFLORE
MONTGOMERY
WEBSTER
CARROLL
OKTIBBEHA
LOWNDES
CHOCTAW
WASHINGTON
HUMPHREYS
ATTALA
WINSTON
NOXUBEE
HOLMES
LEAKE
NESHOBA
KEMPER
SCOTT
NEWTON
LAUDERDALE
MADISON
SMITH
JASPER
CLARKE
SIMPSON
JEFFERSON
JEFFERSON DAVIS
WAYNE
LINCOLN
FORREST
PERRY
GREENE
LAWRENCE
PIKE
WALTHALL
HARRISON
JACKSON
LOUISIANA
ALABAMA
OIL AND GAS MAP
OF
FIG. 2. MISSISSIPPI
STATE OIL & GAS BOARD

Oil And Gas Developments In Michigan During 1949

By G. E. EDDY * and R. P. GRANT **

Oil and gas activities in Michigan during the year increased over 1948. Drilling permits were issued for 999 oil and gas wells, an increase of about 10 percent over 1948. Of 1,004 wells completed, 439 produced oil, 92 produced gas, and 473 were dry holes. Footage drilled during the year was 2,242,321 feet, an increase of 131,321 feet over 1948. Oil production was 16,503,473 barrels, down slightly from last year. Gas production decreased more than 30 percent to 14,576,497 MCF. The decline in gas production is partly accounted for by a mild winter and increased use of storage reservoirs.

Core drilling reached an all time high with permits issued for 454 tests. Western Michigan continued to be most active in core drilling, with 327 permits. Of 335 exploratory wells drilled during 1949, 33 were productive, a success ratio of about one to ten. Results were 21 new oil fields, two new gas fields, two new oil pays, and the extension of five fields (See Table IV). Wildcat footage drilled was 720,336 feet as compared with 691,420 feet in 1948. The average wildcat was 2,150 feet deep, compared with 2,216 feet a year ago, reflecting continued vigorous exploration in the relatively shallow western and southwestern districts.

Eighteen exploratory wells reached the "Richfield" or deeper formations, (Table II). These wells were distributed through 13 counties. Results were the extension of Adams "Richfield" pool and the discovery of the Butman "Richfield" pool. Six of these wildcats reached the Detroit River Formation, two the Sylvania, one the Bois Blanc, one the Bass Island, two the Salina, one the Cabot Head, one the Cincinnatian, two the Trenton, and two reached the St. Peter.

Active field developments are briefly summarized in Table III. This was set up with the belief that it would more readily show these activities than several pages of text formerly used. We have reviewed and re-calculated the data on proved area and per acre recoveries in fields and feel that they are more accurate than in former years. Figure 2 is a map which shows oil and gas producing areas by formation. Figure 3 is a generalized geological section showing all the Oil and Gas producing horizons.

* STATE GEOLOGIST, GEOLOGICAL SURVEY DIVISION, DEPT. OF CONSERVATION.
** PETROLEUM GEOLOGIST, GEOLOGICAL SURVEY DIVISION, DEPT. OF CONSERVATION.
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Brine produced with the oil in Michigan oil fields increased very noticably during 1949. The 155 oil fields were producing 172,781 barrels of brine per day at the end of 1949. This was an increase of 14,339 barrels per day over the previous year. Reed City, Fork and Redding continue to be the leading brine producing fields. Kimball Lake has joined the Coldwater and Porter Fields in the large volume classification. The relatively new Pentwater and Stony Lake fields have joined the ranks of those fields producing in excess of 1,000 barrels of brine per day. The following chart includes all fields which were producing brine in excess of 2,500 barrels per day at the end of 1949:

Field	Bbls of Brine per day at end of - 1946	1947	1948	1949
Reed City	24,907	31,132	33,473	33,636
Fork	17,617	20,022	20,240	21,224
Redding	14,015	13,415	14,000	13,372
Coldwater	1,698	3,345	9,904	12,109
Kimball Lake	-	879	9,446	11,642
Porter	12,494	10,794	10,655	10,855
North Adams	2,637	4,619	6,209	6,083
Winterfield	4,129	2,951	4,534	5,110
Headquarters	5,755	5,381	4,782	4,930
Freeman	3,275	4,215	4,550	4,575
Bloomingdale	2,679	4,223	3,602	3,689
Vernon	5,090	4,736	3,640	3,530
Prosper	2,642	3,032	2,601	3,213
Sherman	4,663	3,689	3,409	2,832
Yost-Jasper	3,270	1,702	1,977	2,527
Pentwater	-	-	236	2,005
Stony Lake	-	32	154	1,457

It is significant that 171,240 barrels of the 172,781 barrels of brine produced per day at the end of 1949 were being returned to a satisfactory subsurface formation. Slightly less than one per cent of the total brine produced was released on the surface. This small surface release of brine was in accordance with temporary or permanent arrangement with the operators.

The major part of the brine was returned to the Marshall, Traverse, Dundee and Detroit River Formations. This underground disposal of oil field brine was proved physically and economically effective in eliminating damage to property and pollution of surface and ground water resources.

TABLE I - OIL PRODUCTION STATISTICS FOR MICHIGAN DURING 1949

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl	
				AREA PROVED ACRES	BARRELS TO END OF 1949	BARRELS DURING 1949	AREA PROVED ACRES	MILLION CU FT[c] TO END OF 1949	MILLION CU FT[c] DURING 1949		TO END OF 1949	DURING 1949
1	Adams, *Ironic*	Traverse, Dev	1937	640	593,537	29,665						
2	Adams, *Ironic*	Dundee, Dev	1937									
3	Adams, North, *Ironic*	Dundee, Dev	1940	400	8,176,274	161,982						
4	Adams, *Richfield-Ironic & Ray*	Richfield, Dev	1941	760	148,722	86,763						
5	Akron, *Tuscola*	Dundee, Dev	1936	380	305,599	24,357						
6	Akron, *Tuscola*	Detroit River, Dev	1936									
7	Alamo, *Kalamazoo*	Traverse, Dev	1949	10	1,357	1,357						
8	Alleyan, *Allegan*	Traverse, Dev	1937	80	1,720	59						
9	Ariela, *Tuscola*	Dundee, Dev	1946	350	226,616	11,687						
10	Ashton, *Osceola*	Traverse, Dev	1945	200	168,230	27,018						
11	Ashton, *Osceola*	Detroit River, Dev	1945									
12	Atlanta, *Montmorency*	Detroit River, Dev	1945	30	3,006	1,003						
13	Bangor, *Van Buren*	Traverse, Dev	1939	270	603,581	15,212						
14	Bard, *Gladwin*	Dundee, Dev	1949	80	27,149	27,149						
15	Beaver Creek, *Crawford & Kalkaska*	Richfield, Dev	1947	2,800	1,288,818	904,342						
16	Beaverton, *Gladwin*	Dundee, Dev	1934	310	755,321	3,390						
17	Belly Ackers, *Montcalm*	Dundee, Dev	1944	220	223,218	16,807						
18	Bentley, *Gladwin*	Dundee, Dev	1937	1,670	1,309,603	99,678						
19	Billings, *Gladwin*	Dundee, Dev	1949	240	22,964	22,964						
20	Birch Run, *Saginaw*	Berea, Miss	1934	250	215,516	0						
21	Bloomer, *Montcalm*	Traverse, Dev	1944	470	934,191	146,773						
22	Bloomingdale, *Van Buren*	Traverse, Dev	1944	3,670	9,411,363	120,921						
23	Breedsville, *Van Buren*	Traverse, Dev	1943	230	254,537	1,364						
24	Brenner, *Allegan*	Traverse, Dev	1946	200	148,006	1,463						
25	Butman, *Gladwin*	Dundee, Dev	1949	60	3,120	3,120						
26	Butman, *Gladwin*	Richfield, Dev	1949									
27	Casco, *Allegan & Van Buren*	Traverse, Dev	1940	50	12,127	1,124						
28	Cato, *Montcalm*	Dundee, Dev	1944	360	350,713	93,652						
29	Cato, *Montcalm*	Reed City, Dev	1944									
30	Cedar, *Osceola*	Dundee, Dev	1943	420	624,045	50,926						
31	Cedar, *Osceola*	Detroit River, Dev	1943									
32	Chase, *Lake*	Berea, Miss	1943	20	3,303	346						
33	Cheshire, *Allegan*	Traverse, Dev	1947	30	5,584	924						
34	Clare City, *Clare & Isabella*	Mich Stray, Miss	1938	110	46,734	2,890						
35	Clayton, *Genesee & Ironic*	Dundee, Dev	1935	1,290	4,772,596	136,956						
36	Coffee Lake, *Van Buren*	Traverse, Dev	1946	50	30,590	3,570						
37	Coldwater, *Isabella*	Dundee, Dev	1944	3,120	8,254,632	1,672,816						
38	Crooked Lake, *Allegan*	Traverse, Dev	1949	40	28,201	28,201						
39	Crystal, *Montcalm*	Dundee, Dev	1935	1,970	7,433,406	18,074						
40	Currie, *Isabella*	Dundee, Dev	1936	40	174,627	2,121						
41	Dalton, *Muskegon*	Traverse, Dev	1940	300	66,898	4,439						
42	Day, *Montcalm*	Dundee, Dev	1946	20	12,247	2,206						
43	Deep River, *Ironic*	Dundee, Dev	1944	1,060	12,757,949	2,396,157						
44	Deerfield, *Roscommon*	Trenton, Ord	1930	350	495,982	14,483						
45	Diamond Springs, *Allegan*	Traverse, Dev	1938	420	889,738	13,259						
46	Dorr, *Allegan*	Traverse, Dev	1938	350	360,363	6,392						
47	Douglas, *Montcalm*	Dundee, Dev	1945	80	202,346	20,102						
48	Dwight, *Huron*	Detroit River, Dev	1945	10	11,981	1,690						
49	East Monterey, *Allegan*	Traverse, Dev	1938	30	9,566	0						
50	East Norwich, *Missaukee & Roscommon*	Richfield, Dev	1942	2,200	2,096,128	322,368						
51	East Pullman, *Allegan*	Traverse, Dev	1949	10	0	0						
52	E Reed City, *Osceola*	Traverse, Dev	1947	30	16,598	12,596						
53	East Salem, *Allegan*	Traverse, Dev	1938	170	57,303	17,635						
54	Eden, *Mason*	Traverse, Dev	1948									
55	Eden, *Mason*	Dundee, Dev	1948	80	75,364	54,311						
56	Eden, *Mason*	Detroit River, Dev	1948									
57	Edenville, *Midland*	Dundee, Dev	1938	370	1,299,830	13,565						
58	Edmore, *Montcalm*	Traverse, Dev	1933	90	502,523	12,564						
59	Edwardsburg, *Cass*	Traverse, Dev	1940	30	277	0						
60	Elba, *Gratiot*	Traverse, Dev	1946	60	34,070	2,286						
61	Elmwood, *Tuscola*	Dundee, Dev	1945	20	1,650	1,200						
62	Enterprise, *Missaukee*	Richfield, Dev	1943	440	159,988	80,127						
63	Essexville, *Bay*	Dundee, Dev	1944	1,560	1,363,737	162,255						
64	Evart, *Osceola*	Dundee, Dev	1942	1,100	3,212,088	121,751						
65	Fillmore, *Allegan*	Traverse, Dev	1940	770	774,089	32,603						
66	Fork, *Mecosta*	Dundee, Dev	1942	2,660	6,694,796	307,906						
67	Fork, *Mecosta*	Richfield, Dev	1942	40								
68	Freeman, *Clare*	Dundee, Dev	1938	560	3,779,416	41,526						
69	Freeport, *Barry*	Traverse, Dev	1949	10	8,274	8,274						
70	Geneva, *Van Buren*	Traverse, Dev	1940	680	298,084	155,628						
71	Goodwell, *Newaygo*	Traverse, Dev	1943	1,240	1,004,874	16,812						
72	Harrison, *Clare*	Dundee, Dev	1945	80	56,717	9,759						
73	Hazelhead, *Allegan*	Traverse, Dev	1946	160	51,984	4,610						
74	Headquarters, *Clare & Roscommon*	Traverse, Dev	1946	1,460	6,932,581	112,799						
75	Headquarters, *Clare & Roscommon*	Richfield, Dev	1946	200								
76	Heath, *Allegan*	Traverse, Dev	1948	160	56,049	17,486						
77	Hilliards, *Allegan*	Traverse, Dev	1944	200	107,334	4,390						
78	Holton, *Muskegon*	Traverse, Dev	1948	60	17,203	14,341						
79	Hope, *Barry*	Traverse, Dev	1939	300	123,683	43,793						
80	Hopkins, *Allegan*	Traverse, Dev	1939	110	140,623	1,497						
81	Hubbardston, *Ionia*	Dundee, Dev	1947	40	11,623	6,535						
82	Isabella, *Isabella*	Dundee, Dev	1948	330	265,682	256,089						
83	Jerome, *Midland*	Dundee, Dev	1947	240	91,602	54,848						

LINE NUMBER	NUMBER OF WELLS[e]			WELLS PRODUCING[f] DEC. 1949			RESERVOIR PRESSURE LB PER SQ INCH		SECONDARY RECOVERY[g]	CHARACTER OF OIL[h]		PRODUCING FORMATION					DEEPEST ZONE TESTED[n] TO END OF 1949	
	COMPLETED TO END 1949	1949		OIL		GAS	INITIAL	AVG. / END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT[k]	PROD. THICKNESS AVG. FT / NET	STRUCTURE[m]	NAME	DEPTH OF HOLE, FT
		COMPLETED	ABANDONED	FLOWING	ARTIFICIAL LIFT													
1	11	3	1		6					37.0		L	P	2,032	15	A	Sylvania	4,960
2	33	3	0		25					34.7		L	P	2,874	15	A	Sylvania	4,960
3	48	0	4		25							L	P	2,878	15	A	Sylvania	4,960
4	21	12	0		16							L	P	4,278	5	A	Sylvania	4,960
5	3	0	0		0					37.3		L	P	2,678		A	Detroit River	4,001
6	13	0	0		10							D	P			A		
7	1	1	0		1							L	P	1,310		A	Traverse	1,390
8	8	1	3		0							L	P	1,963		A	Bass Island	1,875
9	33	0	1		32							L	P	2,557		A	Dundee	3,375
10	2	0	0		2					42.0		L	P	2,950		A	Detroit River	3,686
11	3	0	0		3					40.0		L	P	3,645		A	Detroit River	3,686
12	3	0	1		2							D	P	2,183		A	Detroit River	2,550
13	34	0	1		9					29.5		L	P	1,002	2	A	Trenton	2,552
14	8	8	0		8							L	P	4,017		A	Dundee	4,017
15	70	28	0		70							D	P	4,160		A	Detroit River	4,460
16	24	0	0		2					41.3		L	P	3,929	12	A	Dundee	3,978
17	7	0	0		4					48.2		D	P	3,470	(1.3)	A	Dundee	3,615
18	63	7	0		49					42.1		L	P	3,510	(1.5)	A	Sylvania	5,114
19	11	11	0		11							L	P	3,549		A	Dundee	3,720
20	26	0	0		1					43.3		S	P	1,530	5	A	Dundee	2,646
21		3	4		20					42.3		L	P	2,640	(3.3)	A	Detroit River	3,271
22	394	14	16		86					42.0		L	P	1,244	4	A	Trenton	3,007
23	28	0	1		2					33.0		L	P	1,061	2	A	Detroit River	1,445
24	21	0	1		2							L	P	1,680		A	Detroit River	2,045
25	1	1	0		1							L	P	3,596		A	Sylvania	5,027
26	1	1	0		1							D	P	4,921		A	Sylvania	5,027
27	8	0	0		4					38.6		L	P	1,095		A	Traverse	1,115
28		0	1		1							L	P	3,065		A	Detroit River	3,731
29		0	1		13							D	P			A	Detroit River	3,731
30	10	0	0		9					46.0		L	P	3,810		A	Sylvania	5,160
31	1	0	0		1							L	P	5,060		A	Sylvania	5,160
32	2	0	0		2							S L	P	2,460		A	Detroit River	3,734
33	3	0	1		1							L	P	1,289		A	Traverse	1,348
34	6	0	0		5					30.2		S	P	1,303	2	A	Dundee	3,853
35	78	0	0		53					34.2		D L	P	2,465	12	A	Sylvania	4,163
36	8	2	2		2							L	P	1,128		A	Traverse	1,130
37	79	0	1		74					46.0		L	P	3,692	13	A	Detroit River	5,090
38	2	2	0		2							L	P	1,312		A	Traverse	1,312
39	185	0	3		11					43.5		D	P	3,187	4	A	Detroit River	3,391
40	2	0	0		2					45.9		L	P	3,918		A	Dundee	4,042
41	16	0	0		11							L	P	1,851		A	Dundee	2,515
42	2	0	0		2							L	P	3,337		A	Dundee	3,345
43	105	1	3		102					43.0		D	P	2,795	5	A	Dundee	2,854
44	36	0	2		14					43.2		L	P	2,115	9	M F	Cambrian	3,250
45	56	0	3		13					42.7		L	P	1,461	3	A	Traverse	1,783
46	36	1	0		7					41.0		L	P	1,617	4	A	Niagaran	3,319
47		0	1		5					41.0		L	P	3,400		A	Dundee	3,458
48	1	0	0		1					47.1		L	P	2,862		A	Detroit River	2,878
49	3	0	1		0					36.2		L	P	1,752		A	Traverse	1,752
50		2	0		55							D	P	4,390		A	Sylvania	4,632
51	1	1	0		1							L	P	1,131		A	Traverse	1,220
52	3	1	0		3							L	P	3,106		A	Detroit River	3,780
53	16	1	0		16							L	P	1,650		A	Traverse	1,700
54	3	0	1		2					34.5		L	P	1,679		A		
55	1	0	0		1							L	P	2,240		A	Detroit River	2,359
56	3	0	1		2							D	P	2,345		A		
57		0	1		17							L	P	3,790	8	A	Dundee	3,962
58		0	0		7					43.2		L	P	3,150	4	A	Dundee	3,613
59	4	0	0		1					28.0		L	P	673		A	Detroit River	960
60		1	0		2					47.0		L	P	2,440		A	Dundee	3,044
61	2	1	0		1					31.3		L	P	2,740		A	Bois Blanc	3,945
62		5	0		12							D	P	4,405		A	Detroit River	4,625
63		4	0		37							L	P	2,835	17	A	Sylvania	4,130
64		0	2		23							L	P	2,755	6	A	Sylvania	5,292
65	63	0	1		41					41.1		L	P	1,516	(2.7)	A	Bass Island	2,455
66		0	2		53					50.1		L	P	3,845	2	A	Sylvania	5,198
67	1	0	0		1					54.8		D	P	5,001		A	Sylvania	5,198
68		0	0		13							L	P	3,885	(4.5)	A	Sylvania	5,462
69	1	1	0		1							L	P	2,031		A	Detroit River	2,430
70	68	16	25		35					31.5		L	P	1,042		A	Traverse	1,163
71		0	0		5					43.0		L	P	2,760	12	A	Bass Island	4,342
72		0	0		2					39.7		L	P	4,190		A	Sylvania	5,633
73	15	0	1		5							L	P	1,103		A	Detroit River	1,395
74		0	4		21					42.3		L	P	3,380	5	A	Bois Blanc	5,929
75		0	0		4					48.9		D	P	4,955	13	A	Bois Blanc	5,929
76	14	0	1		12							L	P	1,498		A	Traverse	1,560
77	15	0	0		4							L	P	1,576	(1.2)	A	Traverse	1,608
78	3	2	0		3							L	P	1,993		A	Detroit River	2,554
79	30	11	0		25					37.6		L	P	1,869		A	Detroit River	2,300
80	10	1	2		1					41.5		L	P	1,633		A	Detroit River	1,965
81	4	3	0		4							L	P	3,028		A	Dundee	3,072
82	18	17	0		18					46.9		D	P	3,783		A	Detroit River	3,993
83	11	3	0		11							L	P	3,743		A	Detroit River	4,001

TABLE I — CONTINUED OIL PRODUCTION STATISTICS FOR MICHIGAN DURING 1949

LINE NUMBER	FIELD (County)[2]	PRODUCING FORMATION NAME AND AGE[3]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO[4] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl	
				AREA PROVED ACRES	BARRELS TO END OF 1949	BARRELS DURING 1949	AREA PROVED ACRES	MILLION CU. FT. TO END OF 1949	MILLION CU. FT. DURING 1949		TO END OF 1949	DURING 1949
84	Kawkawlin, *Bay*	Berea, Dev	1938	5,640	5,766,993	754,742						
85	Kawkawlin, *Bay*	Dundee, Dev	1938									
86	Kellogg, *Allegan*	Traverse, Dev	1949	10	0	0						
87	Kimball Lake, *Newaygo*	Traverse, Dev	1947	2,140	3,601,884	1,119,470						
88	Lacota, *Van Buren*	Traverse, Dev	1946	100	41,928	10,299						
89	Lakefield, *Saginaw*	Dundee, Dev	1937	10	12,246	974						
90	Leaton, *Isabella*	Dundee, Dev	1930	490	1,647,210	6,227						
91	Lebanon, *Clinton*	Traverse, Dev	1948	10	888	695						
92	Lee, *Allegan*	Traverse, Dev	1941	40	2,652	749						
93	Martin, *Allegan*	Traverse, Dev	1948	10	889	889						
94	Mears, *Oceana*	Dundee, Dev	1949	60	24,827	24,827						
95	Mio, *Montmorency & Oscoda*	Richfield, Dev	1946	80	1,480	0						
96	Monterey, *Allegan*	Traverse, Dev	1938	540	625,033	24,619						
97	Mount Forest, *Bay*	Dundee, Dev	1947	880	242,536	88,591						
98	Mount Pleasant, *Isabella & Midland*	Dundee, Dev	1928	5,600	24,556,340	233,720						
99	Muskegon, *Muskegon*	Traverse, Dev	1928	3,130	6,834,329	13,151						
100	Muskegon, *Muskegon*	Dundee, Dev	1928									
101	New Boston, *Wayne*	Trenton, Ord	1943	20	2,349	123						
102	New Salem, *Allegan & Ottawa*	Traverse, Dev	1938	1,120	4,262,209	90,276						
103	Niles, *Berrien*	Traverse, Dev	1940	30	6,233	1,099						
104	North Bangor, *Van Buren*	Traverse, Dev	1942	300	302,519	1,787						
105	North Buckeye, *Gladwin*	Dundee, Dev	1939	2,720	16,334,948	154,549						
106	North Hamilton, *Clare*	Dundee, Dev	1943	20	17,260	2,023						
107	Otisville, *Genesee*	Berea, Miss	1945									
108	Otisville, *Genesee*	Traverse, Dev	1941	100	27,175	6,994						
109	Otisville, *Genesee*	Dundee, Dev	1941									
110	Overisel, *Allegan*	Traverse, Dev	1938	1,770	2,512,721	34,111						
111	Paris, *Mecosta*	Traverse, Dev	1949	80	50,122	50,122						
112	Pentwater, *Mason & Oceana*	Traverse, Dev	1948	1,920	1,725,226	1,332,893						
113	Pentwater, *Mason & Oceana*	Dundee, Dev	1948									
114	Pinconning, *Bay*	Dundee, Dev	1944	50	317,244	74,845						
115	Pine, *Montcalm*	Traverse, Dev	1938	10	65,216	3,814						
116	Pine River, *Gratiot*	Dundee, Dev	1942	80	12,121	410						
117	Polkton, *Ottawa*	Traverse, Dev	1942	60	15,832	3,010						
118	Porter, *Midland*	Dundee, Dev	1933	4,630	36,062,170	353,513						
119	Prosper, *Missaukee*	Dundee, Dev	1942	480	1,126,645	63,302						
120	Pullman, *Allegan*	Traverse, Dev	1949	60	17,757	17,757						
121	Redding, *Clare*	Dundee, Dev	1938	2,310	11,354,887	146,612						
122	Reed City, *Lake & Osceola*	Traverse, Dev	1941									
123	Reed City, *Lake & Osceola*	Dundee, Dev	1940	5,320	36,998,555	943,919						
124	Reed City, *Lake & Osceola*	"Reed City", Dev	1941									
125	Riverside, *Missaukee*	Dundee, Dev	1942	20	51,166	3,267						
126	Rockford, *Kent*	Traverse, Dev	1945	180	312,943	31,899						
127	Rosebush-*Isabella*	Dundee, Dev	1933	750	1,206,553	91,868						
128	Rose City-*Ogemaw*	Richfield, Dev	1942	560	262,133	54,043						
129	Rose Lake-*Osceola*	Traverse, Dev	1943	660	1,128,725	59,377						
130	Saginaw, *Saginaw*	Berea, Dev	1925	1,500	1,507,332	13,459						
131	Salem, *Allegan*	Traverse, Dev	1937	2,040	3,401,881	39,791						
132	Sauble, *Lake*	Traverse, Dev	1942	200	101,366	7,579						
133	"Sec 13 Pinconning", *Oceana*	Traverse, Dev	1949	10	0	0						
134	"Sec 33 Big Prairie", *Newaygo*	Dundee, Dev	1947		51	51						
135	"Sec 23 Cedar Creek", *Muskegon*	Traverse, Dev	1949	10	0	0						
136	"Sec 5 Comstock", *Kalamazoo*	Traverse, Dev	1949	10	384	384						
137	"Sec 9 Denver", *Newaygo*	"Berea", Miss	1949	10	0	0						
138	"Sec 9 Jonesfield", *Saginaw*	Dundee, Dev	1949	10	35	35						
139	"Sec 21 Monterey", *Allegan*	Traverse, Dev	1949	10	0	0						
140	"Sec 36 Monterey", *Allegan*	Traverse, Dev	1949	10	0	0						
141	"Sec 29 Pinconning", *Bay*	Traverse, Dev	1949	20	2,315	2,315						
142	"Sec 8 Watson", *Allegan*	Traverse, Dev	1949	10	0	0						
143	Sherman, *Isabella*	Dundee, Dev	1936	1,000	4,516,949	34,763						
144	South Akron, *Tuscola*	Dundee, Dev	1941	140	36,037	22,743						
145	South Beaverton, *Gladwin*	Dundee, Dev	1936	660	843,986	90,925						
146	South Buckeye, *Gladwin*	Dundee, Dev	1936	2,300	4,381,445	48,520						
147	South Hopkins, *Allegan*	Traverse, Dev	1948	320	170,561	83,497						
148	South Lee, *Allegan*	Traverse, Dev	1949	120	61,502	61,502						
149	South Monterey, *Allegan*	Traverse, Dev	1944	150	107,309	1,073						
150	South Talmadge, *Ottawa*	Traverse, Dev	1939	870	647,042	53,606						
151	St Helen, *Roscommon*	Richfield, Dev	1941	1,120	605,068	156,569						
152	Standish, *Arenac*	Detroit River, Dev	1948	40	6,276	3,800						
153	Sterling, *Arenac*	Dundee, Dev	1947	210	67,696	38,858						
154	Stony Lake, *Oceana*	Berea, Dev	1949									
155	Stony Lake, *Oceana*	Traverse, Dev	1946	1,300	2,131,987	861,046						
156	Sylvan, *Osceola*	Dundee, Dev	1948	440	245,992	212,782						
157	Trent, *Muskegon*	Traverse, Dev	1949	40	14,662	14,662						
158	Trombridge, *Allegan*	Traverse, Dev	1937	830	236,559	6,171						
159	Vernon, *Isabella*	Dundee, Dev	1930	890	4,752,292	28,851						
160	Walker-*Kent & Ottawa*	Traverse, Dev	1938	5,680	11,045,060	199,568						
161	Wayland, *Allegan*	Traverse, Dev	1944	80	14,672	5,633						
162	West Beaverton, *Gladwin*	Dundee, Dev	1943	20	10,370	1,280						
163	West Branch, *Ogemaw*	Dundee, Dev	1933	3,120	6,506,792	189,913						
164	West Hopkins, *Allegan*	Traverse, Dev	1941	370	388,777	0						
165	Wheatland, *Mecosta*	Dundee, Dev	1945	80	70,238	7,515						
166	Winfield, *Montcalm*	Dundee, Dev	1936	40	61,470	881						

LINE NUMBER	NUMBER OF WELLS[a]			WELLS PRODUCING[f] DEC. 1949			RESERVOIR PRESSURE LB. PER SQ. INCH		SECONDARY RECOVERY[g]	CHARACTER OF OIL[h]		PRODUCING FORMATION					DEEPEST ZONE TESTED[n] TO END OF 1949	
	COMPLETED TO END 1949	1949		OIL		GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT.	PROD. THICKNESS AVG. FT. NET	STRUCTURE[m]	NAME	DEPTH OF HOLE, FT.
		COMPLETED	ABANDONED	FLOWING	ARTIFICIAL LIFT													
84		0	0		3					38.0		S	P	1,505	4	A	St. Peter	10,447
85		40	0		252					35.0		L	P	2,830	36	A	St. Peter	10,447
86	1	1	0		1							L	P	1,466		A	Traverse	1,466
87	106	0	8		98					43.3		L	P	2,332		A	St. Peter	6,689
88	9	2	0		2							L	P	1,110		A	Traverse	1,208
89	1	0	0		1					39.0		L	P	3,185		A	Dundee	3,197
90		0	0		1					43.0		L	P	3,655	(7.5)	A	Detroit River	4,390
91	1	0	0		1							L	P	2,548	1	A	Traverse	2,570
92	4	3	2		1							L	P	1,170		A	Traverse	1,207
93	1	0	0		1							L	P	1,617		A	Traverse	1,645
94	3	3	0		3							L	P	2,210		A	Dundee	2,288
95	2	1	0		1							D	P	4,180		A	Bois Blanc	5,133
96	51	0	9		29					37.6		L	P	1,618	3	A	Detroit River	2,039
97	26	6	0		26							D	P	3,025		A	Dundee	3,037
98		5	2		160					41.8		L	P	3,545	15	A	Sylvania	4,821
99		0	0		21					37.4		L	P	1,700	(3.5)	A	St. Peter	4,754
100		0	0							32.0		L	P	2,025	10	A	St. Peter	4,754
101	2	0	1		0							L	P	2,635		A	Trenton	2,983
102	101	1	2		61					41.0		L	P	1,623	6	A	Traverse	1,738
103	3	0	0		3					21.5		L	P	645		A	Traverse	671
104	27	0	1		5					32.6		L	P	1,017	1	A	Traverse	1,018
105		0	6		119					39.0		L	P	3,615	11	A	Sylvania	5,351
106	1	0	0		1							L	P	4,078		A	Dundee	4,137
107												S	P	1,500		A	Dundee	2,674
108	9	1	0		7					44.3		L	P	1,895		A	Dundee	2,674
109										37.0		L	P	2,450		A	Dundee	2,674
110	164	0	3		44					42.1		L	P	1,678	3	A	Detroit River	1,903
111	4	4	0		4							D	P	2,890		A	Dundee	3,545
112	38	30	0		38							L	P	1,585	9.5	A	Detroit River	2,274
113	91	47	0		91					43.1		L	P	2,088		A	Detroit River	2,274
114		1	1		4					36.2		D	P	2,898		A	Dundee	3,308
115	1	0	0		1					45.0		L	P	2,836		A	Dundee	3,285
116	2	0	0		2							L	P	3,290		A	Dundee	3,295
117	6	0	0		3							L	P	1,878		A	Traverse	1,915
118		0	4		200					40.6		L	P	3,415	12	A	Sylvania	4,738
119	13	0	0		11					43.2		L	P	3,837	4	A	Dundee	3,898
120	6	6	1		5							L	P	1,185		A	Bass Island-Salina	1,892
121		0	2		48					43.8		L	P	3,885	5	A	Sylvania	5,462
122												L	P	2,925	5	A	St. Peter	8,917
123		0	10		170					46.3		L	P	3,490	3	A	St. Peter	8,917
124												D	P	3,585	7	A	St. Peter	8,917
125	1	0	0		1					44.5		L	P	3,944		A	Dundee	3,953
126	18	0	1		17					44.0		L	P	2,204		A	Detroit River	2,685
127	36	1	0		33					43.0		L	P	3,690		A	Detroit River	4,322
128		1	0		14					41.2		D	P	4,075	8	A	Sylvania	5,367
129	18	0	1		14					45.4		L	P	3,140	5	A	Detroit River	3,990
130		0	0		26					38.3		S	P	1,583	16	A	Trenton	3,792
131	330	2	4		153							L	P	1,583	8	A	Trenton	3,797
132	5	0	0		3					35.6		L	P	2,111	2	A	Traverse	2,156
133	1	1	0		1							L	P	1,640		A	Detroit River	2,226
134	1	0	0		1							L	P	2,883		A	Dundee	3,102
135	1	1	0		1							L	P	1,951		A	Dundee	2,453
136	1	1	0		1							L	P	1,430		A	Traverse	1,480
137	1	1	0		1							S-L	P	1,512		A	Detroit River	2,742
138	1	1	1		0							L	P	3,373		A	Dundee	3,409
139	1	1	0		1							L	P	1,825		A	Traverse	1,827
140	1	1	0		1							L	P	1,507		A	Traverse	1,518
141	1	1	0		1							L	P	2,234		A	Dundee	2,238
142	1	1	0		1							L	P	1,779		A	Traverse	1,781
143		0	4		19					42.0		D	P	3,650	4	A	Sylvania	4,994
144	13	10	0		11							L	P	2,850		A	Detroit River	4,001
145		6	0		23					41.1		L	P	3,845	12	A	Detroit River	4,977
146		0	1		45					39.0		L	P	3,570	11	A	Dundee	3,889
147	35	16	2		33							L	P	1,538		A	Traverse	1,611
148	12	12	2		10							L	P	1,171		A	Traverse	1,422
149	14	0	0		4					40.0		L	P	1,623		A	Traverse	1,768
150	77	10	0		70					38.6		L	P	1,834	8	A	Traverse	2,030
151	29	9	0		29					43.4		D	P	4,180	8	A	Detriot River	4,439
152	1	0	0		1							D	P	4,108		A	Detroit River	4,210
153		1	0		21							L	P	2,872		A	Detroit River	4,295
154	1	1	0		1					48.0		S-L	P	930		A	Salina	3,837
155		28	0		61					44.9		L	P	1,630		A	Salina	3,837
156	11	?	1		10					48.0		D	P	3,925	?	A	Dundee	4,100
157	2	2	0		2							L	P	2,039		A	Traverse	2,118
158	64	2	3		6					41.2		L	P	1,358	2	A	Detroit River	1,624
159		0	0		9					44.1		D-L	P	3,755	3	A	Dundee	3,890
160	307	1	8		310					40.0		L	P	1,872		A	St. Peter	5,222
161	8	4	0		8							L	P	1,799	6	A	Traverse	1,830
162		0	0		1							L	P	3,876		A	Dundee	3,912
163		0	17		191					36.8		L	P	2,650	20	A	Cambro-Ordovician	11,012
164	31	0	0		2					41.5		L	P	1,571	2	A	Traverse	1,726
165		0	0		1					43.0		L	P	3,690		A	Dundee	3,849
166	4	0	0		3					43.2		L	P	3,340	1	A	Dundee	3,430

LINE NUMBER	FIELD (County)[A]	PRODUCING FORMATION NAME AND AGE[B]	YEAR OF DISCOVERY	OIL PRODUCTION AREA PROVED ACRES	OIL PRODUCTION BARRELS TO END OF 1949	OIL PRODUCTION BARRELS DURING 1949	GAS PRODUCTION AREA PROVED ACRES	GAS PRODUCTION MILLION CU FT[C] TO END OF 1949	GAS PRODUCTION MILLION CU FT[C] DURING 1949	GAS/OIL RATIO[D] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl TO END OF 1949	CONDENSATE PRODUCTION Thousands of Bbl DURING 1949
167	Winterfield, *Clare*	Traverse, Dev	1940									
168	Winterfield, *Clare*	Dundee, Dev	1940	1,190	4,200,541	106,702						
169	Winterfield, *Clare*	Detroit River, Dev	1940									
170	Wise, *Isabella*	Dundee, Dev	1938	1,610	2,972,657	128,786						
171	Woodville, *Tuscola*	Traverse, Dev	1943	320	258,749	20,287						
172	Wyoming Park, *Kent*	Traverse, Dev	1939	300	144,580	1,883						
173	Yost Vasper, *Midland*	Dundee, Dev	1932	1,990	8,235,961	140,417						
174	Zeeland, *Ottawa*	Traverse, Dev	1942	400	272,085	9,864						
					MISCELLANEOUS AND ABANDONED PRODUCTION							
						YEAR ABAND						
175	Barton, *Newaygo*	Traverse, Dev	1947	10	1,195	1947						
176	Bodnell, *Montcalm*	Dundee, Dev	1935	10	4,035	1939						
177	Calvin, *Cass*	Traverse, Dev	1941	10	67	1946						
178	Cranberry Lake, *Clare*	Dundee, Dev	1943	40	17,508	1947						
179	Crystal, *Oceana*	Traverse, Dev	1945	30	1,497	1946						
180	Dallas, *Clinton*	Traverse, Dev	1942	40	3,085	1948						
181	Durant Lake, *Allegan*	Traverse, Dev	1945	10	368	1947						
182	Elkland, *Tuscola*	Dundee, Dev	1946	20	1,546	1947						
183	Fremont, *Isabella*	Dundee, Dev	1938	10	2,771	1939						
184	Fremont, *Saginaw*	Dundee, Dev	1946	20	2,000	1947						
185	Garfield, *Clare*	Detroit River, Dev	1946	40	13,769	1948						
186	Geneva, *Midland*	Dundee, Dev	1935	60	60,996	1941						
187	Gilman, *Iosco*	Traverse, Dev	1935	20	3,573	1938						
188	Grant, *Gladwin*	Dundee, Dev	1940	100	34,262	1947						
189	Hamilton, *Clare*	Dundee, Dev	1940	10	10,344	1940						
190	Hart, *Oceana*	Traverse, Dev	1933	150	116,275	1936						
191	Hatton, *Clare*	Dundee, Dev	1941	160	139,272	1948						
192	Larkin, *Midland*	Berea, Miss	1935	20	7,070	1945						
193	Logan, *Huron*	Sylvania, Dev	1928	20	228	1944						
194	Maine, *Ottawa*	"Berea", Miss	1940	20	6,253	1946						
195	Mount Haley, *Midland*	Dundee, Dev	1934	10	36,069	1947						
196	North Porter, *Cass*	Traverse, Dev	1930	10	1,008	1940						
197	Otsego, *Allegan*	Traverse, Dev	1938	100	2,275	1946						
198	Porter, *Van Buren*	Traverse, Dev	1939	20	3,931	1948						
199	Richland, *Saginaw*	Traverse, Dev	1936	10	1,871	1939						
200	Sweed, *Gladwin*	Dundee, Dev	1937	20	12,024	1941						
201	"Sec 18 Bloomer", *Montcalm*	Traverse, Dev	1936	10	814	1936						
202	"Sec 30 Bloomfield", *Huron*	Traverse, Dev	1940	10	71	1941						
203	"Sec 5 Blue Lake", *Muskegon*	Traverse, Dev	1940	10	26	1941						
204	"Sec 4 Decatur", *Van Buren*	Traverse, Dev	1942	20	38	1942						
205	"Sec 8 Gaines", *Kent*	Traverse, Dev	1945	10	47	1945						
206	"Sec 35 Heath", *Allegan*	Traverse, Dev	1945	10	599	1946						
207	"Sec 21 Hinton", *Osceola*	Traverse, Dev	1948	10	66	1948						
208	"Sec 29 Jamestown", *Ottawa*	Traverse, Dev	1942	40	52	1942						
209	"Sec 26 Janesfield", *Saginaw*	Dundee, Dev	1943	10	63	1943						
210	"Sec 9 Lincoln", *Midland*	Berea, Miss	1939	10	71	1939						
211	"Sec 1 Mt Forest", *Bay*	Dundee, Dev	1946	10	1,906	1946						
212	"Sec 5 Oshtemo", *Kalamazoo*	Traverse, Dev	1944	10	90	1944						
213	"Sec 11 Overisel", *Allegan*	Traverse, Dev	1940	10	6,370	1944						
214	"Sec 18 Sherman", *Isabella*	Traverse, Dev	1939	20	1,364	1947						
215	"Sec 11 Shiawassee", *Shiawassee*	Traverse, Dev	1930	10	236	1931						
216	"Sec 22 Stanton", *Wayne*	Trenton, Ord	1941	10	221	1942						
217	"Sec 15 Tyrone", *Kent*	Traverse, Dev	1946	10	191	1946						
218	Silver Creek, *Cass*	Traverse, Dev	1939	20	25	1943						
219	Shively, *Clare*	Detroit River, Dev	1942	20	1,485	1944						
220	South Salem, *Allegan*	Traverse, Dev	1947	30	1,220	1948						
	TOTALS			11,985	306,550,254	16,517,333						

LINE NUMBER	NUMBER OF WELLS[d]			WELLS PRODUCING[f] DEC. 1949			RESERVOIR PRESSURE LB. PER SQ. INCH		SECONDARY RECOVERY[g]	CHARACTER OF OIL[h]		PRODUCING FORMATION					DEEPEST ZONE TESTED[m] TO END OF 1949	
	COMPLETED TO END 1949	1949		OIL		GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT.[k]	PROD. THICKNESS AVG. FT.[l] NET	STRUCTURE[n]	NAME	DEPTH OF HOLE, FT.
		COMPLETED	ABANDONED	FLOWING	ARTIFICIAL LIFT													
167												L	P	3,105		A	Sylvania	5,100
168		0	0		26					44.2		L	P	3,770		A	Sylvania	5,100
169												D	P	5,015		A	Sylvania	5,100
170		1	1		56					45.2		L	P	3,700	11	A	Sylvania	5,205
171		0	0		7							L	P	2,820	5	A	Detroit River	3,534
172	21	0	1		3					39.0		L	P	1,870	6	A	Traverse	2,255
173		0	0		73					40.6		L	P	3,420		A	Sylvania	4,733
174	20	0	0		8					41.9		L	P	1,514	3	A	Traverse	1,712
175	1	0	0		0					30.0		L	P	3,097		A	Dundee	3,718
176	1	0	0		0							L	P	3,105		A	Dundee	3,125
177	1	0	0		0					38.0		L	P	952		A	Traverse	968
178	2	0	0		0							L	P	3,835		A	Detroit River	5,201
179	2	0	0		0							L	P	1,839	2	A	Salina	3,643
180	3	0	0		0							L	P	2,482	2	A	Detroit River	2,934
181	1	0	0		0							L	P	1,477		A	Traverse	1,480
182	2	0	0		0							L	P	2,653		A	Sylvania	3,735
183	1	0	0		0							D	P	3,696	4	A	Dundee	3,700
184	2	0	0		0							L	P	3,125		A	Dundee	3,150
185	1	0	0		0							D	P	5,013	10	A	Sylvania	5,307
186	5	0	0		0							L	P	3,678		A	Dundee	3,690
187	2	0	0		0							L	P	2,036		A	Dundee	2,998
188	4	0	0		0							L	P	3,825		A	Dundee	3,850
189	1	0	0		0							L	P	3,751		A	Dundee	3,800
190		0	0		0					34.0		D C	P	1,911	4	A	Dundee	3,439
191	4	0	0		0							L	P	3,945		A	Dundee	4,000
192	2	0	0		0							S	P	2,473	4	A	Dundee	3,829
193	2	0	0		0					42.6		L	P	3,292		A	Sylvania	3,300
194	2	0	0		0							S L	P	1,170		A	Traverse	1,200
195	1	0	0		0					39.6		D	P	3,477		A	Dundee	3,500
196	1	0	0		0							L	P	660		A	Traverse	725
197	4	0	0		0							L	P	1,532		A	Traverse	1,600
198	2	0	0		0							L	P	1,140		A	Traverse	1,150
199	1	0	0		0					46.0		L	P	2,739		A	Dundee	3,264
200	2	0	0		0							L	P	3,437		A	Dundee	3,500
201	1	0	0		0							L	P	2,717		A	Dundee	3,138
202	1	0	0		0							L	P	1,425		A	Traverse	1,427
203	1	0	0		0							L	P	1,830		A	Traverse	1,840
204	1	0	0		0							L	P	1,025		A	Traverse	1,026
205	1	0	0		0							L	P	1,869		A	Traverse	1,940
206	1	0	0		0							L	P	1,468		A	Traverse	1,470
207	1	0	0		0							L	P	3,090		A	Dundee	3,726
208	1	0	0		0							L	P	1,615		A	Detroit River	2,017
209	1	0	0		0							L	P	3,289		A	Dundee	3,305
210	1	0	0		0							S	P	2,515		A	Dundee	3,854
211	1	0	0		0							L	P	2,960		A	Dundee	3,057
212	1	0	0		0					31.0		L	P	1,392		A	Traverse	1,392
213	1	0	0		0							L	P	1,553		A	Traverse	1,578
214	3	0	0		0							L	P	3,217		A	Dundee	3,835
215	1	0	0		0							L	P	1,800		A	Dundee	2,410
216	1	0	0		0							L	P	2,625		A	Trenton	2,653
217	1	0	0		0							L	P	2,349		A	Traverse	2,353
218	2	0	0		0							L	P	806	2	A	Detroit River	1,115*
219	1	0	0		0							D	P	4,844		A	Detroit River	4,851
220	2	0	0		0							L	P	1,679		A	Traverse	1,692
		439	190		3,818													

TABLE I-A - GAS PRODUCTION STATISTICS FOR MICHIGAN DURING 1949

LINE NUMBER	FIELD (County)[1]	PRODUCING FORMATION NAME AND AGE[2]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO[3] MCF/BBL	CONDENSATE PRODUCTION (Thousands of Bbl)	
				AREA PROVED ACRES	BARRELS TO END OF 1949	BARRELS DURING 1949	AREA PROVED ACRES	MILLION CU. FT. TO END OF 1949	MILLION CU. FT. DURING 1949		TO END OF 1949	DURING 1949
1	Algonac, *St Clair*	Antrim, Miss - Dev	1947					7.5	7.5			
2	Ashton, *Osceola*	Mich Stray, Miss	1946					91.2	18.4			
3	Austin, *Newaygo*	Mich Stray, Miss	1933					6,109.0		(Storage reservoir)		
4	Big Prairie, *Newaygo*	Mich Stray, Miss	1944					74.9	32.6			
5	Big Rapids, *Mecosta*	Mich Stray, Miss	1943					1,586.4	345.1			
6	Broomfield, *Isabella*	Mich Stray, Miss	1930					10,323.1	189.7			
7	Buckeye, *Gratiot*	Dundee, Dev	1939					9.8	0	(Oil well gas)		
8	Cedar, *Osceola*	Mich Stray, Miss	1945					525.6	122.9			
9	Clare City, *Clare & Isabella*	Mich Stray, Miss	1938					1,924.2	94.4			
10	Clayton, *Arenac*	Herra, Miss	1936					5,111.0	0	(Shut in)		
11	Coldwater, *Isabella*	Miss Stray, Miss	1945					6,446.1	1,304.0			
12	Colfax, *Mecosta*	Miss Stray, Miss	1945					448.7	17.7			
13	Copperville, *Ottawa*	"Herra", Miss	1938					108.8	0			
14	Cranberry Lake, *Clare & Missaukee*	Miss Stray, Miss	1943					7,537.5	0	(Storage reservoir)		
15	Croton, *Newaygo*	Dundee, Dev	1947					49.7	25.1			
16	Crystal, *Montcalm*	Mich Stray, Miss	1935					748.3	19.1			
17	Deep River, *Arenac*	Herra, Miss	1936					1,609.8	0	(Shut in)		
18	Deerfield, *Isabella*	Miss Stray, Miss	1941					1,903.7	78.3			
19	Douglas, *Montcalm*	Miss Stray, Miss	1943					183.1	13.5			
20	Edmore, *Montcalm*	Miss Stray, Miss	1936					6,913.7	161.2	(Includes oil well gas)		
21	Elba, *Gratiot*	Miss Stray, Miss	1946					245.3	52.0			
22	Essexville, *Bay*	Dundee, Dev	1944					2.6	0.8	(Oil well gas)		
23	Evart, *Osceola*	Miss Stray, Miss	1941					3,393.8	182.6	(Includes oil well gas)		
24	Freeman, *Clare*	Miss Stray, Miss	1938					4,482.2	118.7			
25	Fremont, *Isabella*	Miss Stray, Miss	1941					357.7	13.8			
26	Gilmore, *Isabella*	Miss Stray, Miss	1945					197.3	33.4			
27	Goodwell, *Newaygo*	Miss Stray, Miss	1943					5,513.5	0	(Storage reservoir)		
28	Grant, *Mason*	Glacial Drift, Pleistocene	1929					8.0	8.0			
29	Green, *Mecosta*	Miss Stray, Miss	1946					39.0	39.0			
30	Hamilton, *Clare*	Miss Stray, Miss	1940					186.3	78.1			
31	Harrison, *Clare*	Miss Stray, Miss	1945					387.6	76.9			
32	Headquarters, *Roscommon*	Miss Stray, Miss	1946					1,361.9	493.8			
33	Howell, *Livingston*	Salina - Sil	1935					7,333.5	3,970.8			
34	Isabella, *Isabella*	Miss Stray, Miss	1949					121.0	121.0	(Includes oil well gas)		
35	Ithaca, *Gratiot*	Miss Stray, Miss	1943					1,262.4	174.4			
36	Kawkawlin, *Bay*	Dundee, Dev	1938					2.5	0.2	(Oil well gas)		
37	Kimball Lake, *Newaygo*	Traverse, Dev	1947					1,224.5	505.9	(Oil well gas)		
38	Lincoln, *Clare*	Miss Stray, Miss	1938					13,260.8	1,017.9			
39	McKay, *Clare*	Miss Stray, Miss	1929					7,126.3	0			
40	Marion, *Clare & Osceola*	Miss Stray, Miss	1940					20,084.9	0	(Storage reservoir)		
41	Mt Pleasant, *Isabella & Midland*	Dundee, Dev	1928					6,779.1	113.7	(Oil well gas)		
42	Muskegon, *Muskegon*	Traverse, Dev	1927					7,218.2	13.1	(Includes oil well gas)		
43	Muskegon, *Muskegon*	Dundee, Dev	1927									
44	North Star, *Gratiot*	Miss Stray, Miss	1940					268.8	31.2			
45	Northville Salina, *Washtenaw*	Salina, Sil	1937					2.8	2.8			
46	Northwest Crystal, *Montcalm*	Mich Stray, Miss	1936					96.5	0			
47	Orient, *Clare & Osceola*	Mich Stray, Miss	1945					3,596.2	1,283.9			
48	Otsego, *Otsego*	Antrim, Miss & Dev	1940					45.0	6.1			
49	Pentwater, *Oceana & Mason*	Dundee, Dev	1948					219.1	219.1	(Oil well gas)		
50	Porter, *Midland*	Dundee, Dev	1933					2,469.9	0	(Oil well gas)		
51	Pawawna, *Muskegon*	"Herra", Miss	1936					1,432.6	0			
52	Reading, *Clare*	Miss Stray, Miss	1940					1,956.1	0	(Includes oil well gas)		
53	Reed City, *Lake & Osceola*	Miss Stray, Miss	1945					23,320.0	1,000.5	(Includes oil well gas)		
54	Richland, *Montcalm*	Miss Stray, Miss	1940					1,219.2	116.6			
55	Riverside, *Missaukee*	Miss Stray, Miss	1940					4,591.0	476.7			
56	Rolland, *Isabella*	Miss Stray, Miss	1946					293.5	114.7			
57	Salem, *Allegan*	Salina, Sil	1941					143.8	17.2			
58	Shaver, *Gratiot*	Miss Stray, Miss	1935					9,431.8	241.1			
59	Sheridan, *Mecosta*	Miss Stray, Miss	1935					259.8	6.2			
60	Sherman, *Isabella*	Dundee, Dev	1936					641.2	0	(Oil well gas)		
61	Six Lakes, *Mecosta & Montcalm*	Miss Stray, Miss	1934					49,297.0	867.6			
62	South Tallmadge, *Ottawa*	"Herra", Miss	1940					243.0	0.8			
63	Surrey, *Clare*	Mich Stray, Miss	1945					6.1	3.8			
64	Turklake, *Montcalm*	Mich Stray, Miss	1947					128.7	54.6			
65	Vernon, *Isabella*	Mich Stray, Miss	1939					1,455.5	1.2			
66	Walker, *Kent*	"Herra", Miss	1940					4,251.0	39.7	(Includes oil well gas)		
67	Walker, *Kent*	Detroit River, Dev	1940									
68	West Branch, *Ogemaw*	Dundee, Dev	1933					17.8	0	(Oil well gas)		
69	West Evart, *Osceola*	Mich Stray, Miss	1943					1,116.1	79.6			
70	West Fork, *Mecosta, Osceola*	Mich Stray, Miss	1943					1,860.4	223.6			
71	West Fork, *Mecosta*	Detroit River, Dev	1945					257.9	130.2			
72	Winfield, *Montcalm*	Mich Stray, Miss	1935					4,793.6	132.5			
73	Wise, *Isabella*	Mich Stray, Miss	1940					1,647.7	47.9			
74	Woodville, *Newaygo*	Mich Stray, Miss	1943					2,513.7	189.1			
75	Yost-Jasper, *Midland*	Dundee, Dev	1932					2,523.1	0	(Oil well gas)		

LINE NUMBER	NUMBER OF WELLS[e]			WELLS PRODUCING[f] DEC. 1949			RESERVOIR PRESSURE LB PER SQ INCH		SECONDARY RECOVERY[g]	CHARACTER OF OIL[h]		PRODUCING FORMATION					DEEPEST ZONE TESTED[m] TO END OF 1949	
	COMPLETED TO END 1949	1949		OIL		GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT	PROD. THICKNESS AVG. FT / NET	STRUCTURE[k]	NAME	DEPTH OF HOLE, FT
		COMPLETED	ABANDONED	FLOWING	ARTIFICIAL LIFT													
1		8	1			1						S H		302		A	Cabot Head	2,504
2		0	0			3						S		1,215		A	Dundee	3,700
3		0	0			65						S		1,370		A	Detroit River	4,043
4		0	0			1						S		1,030		A	Mich Stray	1,040
5		0	1			6						S		1,145		A	Mich Stray	1,200
6		0	0			33						S		1,355		A	Sylvania	4,994
7												L		3,615		A	Sylvania	5,351
8		0	0			2						S		1,490		A	Sylvania	5,160
9		0	0			5						S		1,290		A	Dundee	3,865
10		0	0			19						S		1,180		A	Sylvania	4,163
11		0	0			15						S		1,390		A	Sylvania	5,090
12		0	0			2						S		1,222		A	Detroit River	4,043
13		0	0			2						S		1,210		A	Traverse	1,900
14		33	0			129						S		1,295		A	Sylvania	5,201
15		0	0			1						L		2,896		A	Dundee	2,900
16		2	0			4						S		1,000		A	Detroit River	3,520
17		0	1			4						S		1,490		A	Sylvania	4,311
18		0	0			10						S		1,415		A	Dundee	3,700
19		0	3			2						S		1,190		A	Dundee	3,423
20		2	1			18						S		1,300		A	Dundee	3,700
21		0	0			2						S		1,670		A	Traverse	2,600
22												L		2,835		A	Sylvania	4,130
23		0	3			13						S		1,410		A	Detroit River	4,457
24		1	0			10						S		1,475		A	Detroit River	3,957
25		0	0			1						S		1,235		A	Detroit River	3,700
26		0	0			2						S		1,560		A	Mass Stray	1,600
27		12	0			56						S		1,135		A	Detroit River	3,562
28		2	0			3						S		632		A	Dundee	2,385
29		0	0			2						S		1,250		A		
30		0	0			4						S		1,270		A	Detroit River	3,800
31		0	1			2						S		1,675		A	Dundee	4,200
32		0	2			9						S		1,340		A	Sylvania	6,029
33		2	0			15						D		3,920		A	St Peter	5,958
34		5	0			5						S		1,454		A	Detroit River	3,950
35		0	0			5						S		900		A	Dundee	3,300
36												L		2,830		A	St Peter	10,447
37												L		2,332		A	St Peter	6,689
38		3	1			41						S		1,513		A	Detroit River	4,285
39		0	1			2						S		1,400		A	Detroit River	4,055
40		14	0			212						S		1,370		A	Detroit River	5,050
41												L		3,545		A	Sylvania	4,821
42		0	0			15						L		1,700		A	St Peter	4,754
43												L		2,025		A	St Peter	4,754
44	1	0	0			1						S		870		A	Dundee	3,100
45	1	0	0			1						D		2,905		A	Trenton	4,111
46		0	0			1						S		1,075		A	Sylvania	4,311
47		0	0			18						S		1,508		A	Sylvania	5,307
48		1	0			3						S H		1,365		x	Dundee	3,949
49												L		2,068		A	Detroit River	2,274
50												L		3,415		A	Sylvania	4,733
51		0	6			9						S L		1,205		A	Dundee	2,306
52		0	0			4						S		1,475		A	Sylvania	5,462
53		7	0			41						S		1,220		A	St Peter	8,960
54		0	0			2						S		1,205		A	Dundee	3,700
55		0	1			9						S		1,435		A	Dundee	4,000
56		0	0			3						S		1,310		A	Detroit River	3,696
57	1	0	0			1						D		2,725		x	Trenton	3,792
58		0	7			26						S		1,020		A	Dundee	3,536
59		0	0			3						S		1,375		A		
60												D L		3,650		A	Sylvania	4,994
61		0	10			68						S		1,270		A	Detroit River	3,790
62		0	0			2						S L		1,940		A	St Peter	5,222
63		0	0			1						S		1,490		A	Dundee	4,000
64		0	0			4						S		1,081		A	Mich Stray	1,100
65		0	0			1						S		1,300		A	Dundee	3,899
66		0	0			5						S		1,150		A	St Peter	5,222
67		0	0			3						L		2,250		A	St Peter	5,222
68												L		2,650		A	Cambro-Ordov	11,012
69		0	0			8						S		1,490		A	Detroit River	4,457
70		0	3			12						S		1,495		A	Sylvania	5,190
71	1	0	0			1						D		5,001		A	Sylvania	5,190
72		0	0			9						S		1,125		A	Detroit River	3,374
73		0	1			7						S		1,250		A	Sylvania	5,305
74		0	0			7						S		1,185		A	Detroit River	3,534
75												L		3,420		A	Sylvania	4,733

TABLE I-A CONTINUED GAS PRODUCTION STATISTICS FOR MICHIGAN DURING 1949

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl	
				AREA PROVED ACRES	BARRELS TO END OF 1949	BARRELS DURING 1949	AREA PROVED ACRES	MILLION CU FT.[c] TO END OF 1949	MILLION CU FT.[c] DURING 1949		TO END OF 1949	DURING 1949
		MISCELLANEOUS AND ABANDONED										
									YEAR ABAND.			
76	Albion, *Calhoun*	Traverse, Dev	1941					6.1	1948			
77	Day, *Montcalm*	Mich Stray, Miss	1934					8.5	1939			
78	East Fork, *Mecosta*	Mich Stray, Miss	1942					102.8	1948			
79	Diamond Crystal, *St Clair*	Niagaran, Sil	1927					136.5	1931			
80	Garfield, *Clare*	Detroit River, Dev	1946					535.8	1948			
81	Leaton, *Isabella*	Mich Stray, Miss	1935					185.6	1940			
82	North Adams, *Hillsdale*	Berea, Miss	1942					1.3	1948			
83	Sec 31 Vernon, *Isabella*	Mich Stray, Miss	1931					1.1	1931			
84	Sylvan, *Oscoola*	Mich Stray, Miss	1941					80.7	1948			
85								247,042.3	14,660.3			

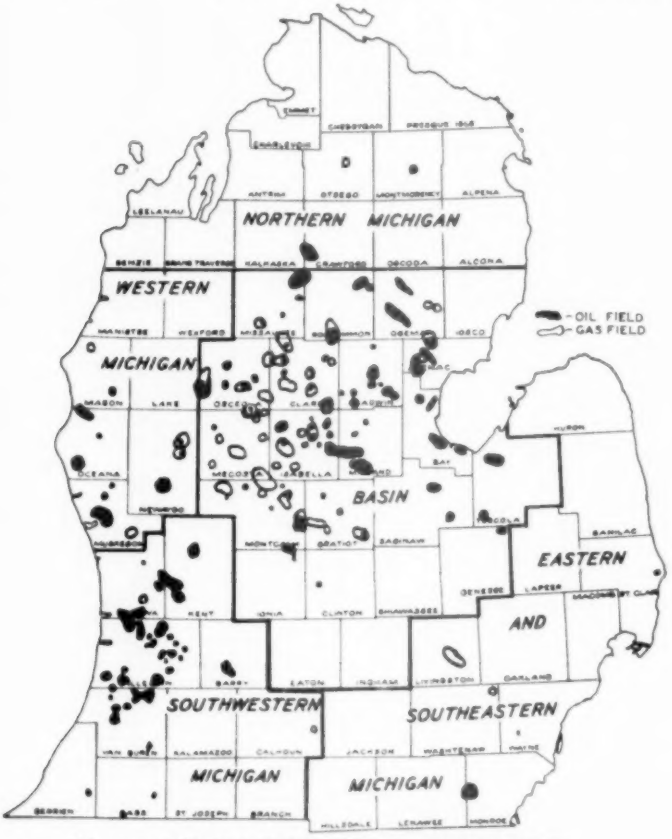

FIG. 1 - MICHIGAN DEPARTMENT OF CONSERVATION
GEOLOGICAL SURVEY DIVISION
1949
SUMMARY OF OPERATIONS
OIL AND GAS FIELDS

LINE NUMBER	NUMBER OF WELLS[e]			WELLS PRODUCING[f] DEC. 1949			RESERVOIR PRESSURE LB. PER SQ. INCH		SECONDARY RECOVERY[g]	CHARACTER OF OIL[h]		PRODUCING FORMATION					DEEPEST ZONE TESTED[n] TO END OF 1949	
	COMPLETED TO END 1949	1949		OIL		GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT.[k]	PROD. THICKNESS AVG. FT. NET	STRUCTURE[m]	NAME	DEPTH OF HOLE, FT
		COMPLETED	ABANDONED	FLOWING	ARTIFICIAL LIFT													
76		0	0			0						L		1,610		A	Trenton	4,286
77		0	0			0						S		1,352		A	Mich Stray	1,375
78		0	0			0						S		1,480		A	Sylvania	5,198
79	1	0	0			0						L		2,483		A	Niagaran	2,500
80	1	0	0			0						S		5,013		A	Sylvania	5,307
81		0	0			0						S		1,240		A	Sylvania	4,390
82	1	0	0			0						S		1,605		A	Dundee	2,100
83	5	0	0			0						S		1,500		A	Dundee	4,055
84		0	0			0						S		1,525		A	Detroit River	4,452
85						0												

FIG. 2 - OIL AND GAS PRODUCING AREAS BY FORMATION

TABLE 2 - IMPORTANT WILDCATS DRILLED IN 1949

LINE NUMBER	COUNTY OR LOCALITY	LOCATION SEC.	LOCATION TWP.	LOCATION RGE.	TOTAL DEPTH, FT. OR METERS	SURFACE FORMATION	DEEPEST HORIZON TESTED	DRILLED BY	INITIAL PRODUCTION PER DAY: OIL, U.S. BBL.	INITIAL PRODUCTION PER DAY: GAS, MILLIONS CU. FT.	INITIAL PRODUCTION PER DAY: CONDENSATE U.S. BBL.	CHOKE, FRACTIONS OF AN INCH	PRESSURE, LB. PER SQ. IN.: CASING	PRESSURE, LB. PER SQ. IN.: TUBING	REMARKS (NOTE DRY HOLES HERE)
		SURVEY	LAT.	LONG.											
1	Allegan	11	1 N	16 W	1,892	Glacial Drift	Bass Island, Sil	Cook & Wadsworth							Dry hole
2	Antrim	13	29 N	7 W	3,548	Glacial Drift	Detroit River, Dev	E.V. Hilliard							Dry hole
3	Arenac	2	19 N	6 E.	4,196	Glacial Drift	Detroit River, Dev	W.L. McClanahan							Dry hole
4	Bay	1	16 N	3 E.	4,263	Glacial Drift	Detroit River, Dev	Ervin Major	50						Extension Disc Adams Richfield pool
5	Cheboygan	1	34 N	2 W	4,650	Glacial Drift	Trenton, Ord	Roosevelt Oil							Dry hole
6	Crawford	26	25 N	2 W	4,462	Glacial Drift	Detroit River, Dev	J.E. Duffy, Jr							Dry hole
7	Gladwin	11	18 N	1 W	5,351	Glacial Drift	Sylvania, Dev	Mogul Oil Co							Dry-Deeper pool test
8	Gladwin	12	20 N	1 W	5,027	Glacial Drift	Detroit River, Dev	Superior Oil Co	28						Disc Putman Richfield pool
9	Kalkaska	6	26 N	5 W	4,623	Glacial Drift	Bois Blanc, Dev	Sun Oil Co							Dry hole
10	Kalkaska	27	25 N	8 W	4,445	Glacial Drift	Sylvania, Dev	Taggart Bros							Dry hole
11	Mason	3	20 N	16 W	2,985	Glacial Drift	Detroit River, Dev	Dow Chem Co							Dry hole
12	Mason	29	17 N	17 W	3,372	Glacial Drift	Salina, Sil	Miller - Goff							Dry hole
13	Monroe	12	6 S	9 E	2,910	Glacial Drift	St Peter, Ord	F.T. Cannon							Dry hole
14	Monroe	22	8 S	8 E	1,830	Glacial Drift	Trenton, Ord	B. Knudenier							Dry hole
15	Newaygo	29	12 N	11 W	3,993	Glacial Drift	Salina, Sil	Sun Oil Co							Dry hole
16	Osceola	29	18 N	10 W	8,917	Glacial Drift	St Peter, Ord	Ohio Oil Co							Dry hole Deeper pool test
17	St Clair	14	6 N	15 E	4,000	Glacial Drift	Cincinnatian, Ord	Arthur Etienne							Dry hole
18	St Clair	36	3 N	15 E	2,504	Glacial Drift	Cabot Head, Sil	Sun Oil Co							Dry hole

TABLE 3 - ACTIVE FIELD DEVELOPMENT IN MICHIGAN DURING 1949

FIELD	COUNTY	YEAR DISCOVERED	WELLS DRILLED IN 1949	NUMBER OF PRODUCING WELLS END OF 1949	INCREASED ACREAGE DURING 1949	AREA ACRES	1949 PRODUCTION	TOTAL PRODUCTION
Adams-Richfield	Arenac & Bay	1941	12	16	480	760	86,763	148,722
Bard	Gladwin	1949	8	8	80	80	27,149	27,149
Beaver Creek	Kalkaska & Crawford	1947	28	70	1,120	2,800	904,342	1,288,818
Billings	Gladwin	1949	11	11	240	240	22,964	22,964
Geneva	Van Buren	1940	16	35	160	680	155,628	298,084
Hope	Barry	1939	11	25	120	300	43,793	123,683
Isabella	Isabella	1948	17	18	210	330	256,089	265,682
Kawkawlin	Bay	1938	40	255	280	5,640	754,742	5,766,593
Pentwater	Mason & Oceana	1948	77	129	1,040	1,920	1,332,893	1,725,226
Pullman	Allegan	1949	6	5	60	60	17,757	17,757
South Akron & Akron	Tuscola	1936	10	21	260	520	47,090	341,636
South Hopkins	Allegan	1948	16	33	130	320	83,497	170,561
South Lee	Allegan	1949	12	10	120	120	61,502	61,502
Stony Lake	Oceana	1946	29	62	0	1,300	861,046	2,131,987

TABLE 4 - DISCOVERY WELLS IN MICHIGAN

COUNTY	FIELD NAME	LOCATION			PERMIT NUMBER	DATE	DEPTH OF PAY ZONE	INITIAL PRODUCTION		PROD. FORMATION
		SEC	TWP	RANGE				OIL BBLS./DAY	GAS M.C.F.	
NEW										
Allegan	Crooked Lake	25	2 N	15 W	15044	6-4-49	1,281	30 Oil 20 Wtr		Traverse
Allegan	Pullman	11	1 N	16 W	15195	7-30-49	1,186	192 Pinched		Traverse
Allegan	East Pullman	6	1 N	15 W	15663	12-30-49	1,131	20/hr		Traverse
Allegan	"Sec 21, Monterey"	21	3 N	13 W	15489	12-5-49	1,825	10 A *		Traverse
Allegan	"Sec 36, Monterey"	36	3 N	13 W	15477	10-17-49	1,507	10 A		Traverse
Allegan	"Sec 8, Watson"	8	2 N	12 W	15447	10-31-49	1,726	3 Oil 15 Wtr		Traverse
Allegan	"Sec 30, Watson"	30	2 N	12 W	13528	12-26-49	1,466	30 Oil 92 Wtr/10 hrs		Traverse
Allegan	South Lee	31	1 N	15 W	14779	2-27-49	1,177	236 A		Traverse
Barry	Freeport	6	4 N	8 W	14991	5-17-49	2,031	70 N **		Traverse
Bay	"Sec 29, Pinconning"	29	17 N	4 E	15297	8-19-49	2,234	84 N		Traverse
Gladwin	Bard	6	17 N	2 W	14760	5-2-49	3,930	57 A		Dundee
Gladwin	Billings	2	17 N	1 E	14633	2-26-49	3,549	75 A		Dundee
Gladwin	Butman	13	20 N	1 W	14934	6-8-49	3,596	62 A		Dundee
Isabella	Isabella	7	15 N	4 W	14713	2-27-49	1,456		3,100	Mich Stray
Kalamazoo	Alamo	30	1 S	12 W	14689	1-20-49	1,310	80 Oil 35 Wtr		Traverse
Kalamazoo	"Sec 5, Comstock"	5	2 S	10 W	15434	10-3-49	1,430	30 Oil 75 Wtr		Traverse
Mecosta	Paris	28	16 N	10 W	14661	6-9-49	2,888	250 N		Traverse
Muskegon	"Sec 23, Cedar Creek"	23	11 N	15 W	15590	12-23-49	1,951	20 Oil 80 Wtr		Traverse
Muskegon	Trent	19	10 N	13 W	14635	1-15-49	2,039	270 A		Traverse
Muskegon	Wolf Lake	7	10 N	15 W	15049	7-9-49	1,050		500	"Berea"
Muskegon	"Sec 9, Denver"	9	14 N	14 W	15039	7-11-49	1,522	?		"Berea"
Oceana	Mears	34	15 N	18 W	14726	2-12-49	2,230	240 A		Dundee
Oceana	"Sec 13, Benona"	13	14 N	18 W	15585	12-17-49	1,670	44 A		Traverse
NEW PAY										
Gladwin	Butman Richfield	12	20 N	1 W	15490	12-13-49	4,921	28 A		Richfield
Mecosta	Paris Dundee	28	16 N	10 W	15161	8-12-49	3,404		1,840	Dundee
Oceana	Stony Lake, Berea	9	13 N	18 W	15522	11-1-49	931	?		"Berea"
Oceana	"Sec, 10, Weare"	10	16 N	17 W	15514	10-31-49	800		116	Berea
Ogemaw	Logan	25	22 N	4 E	14474	1-21-49	1,230		560	"Weir"
FIELD EXTENSIONS										
Bay	South Adams	1	18 N	3 E	13470	3-8-49	4,240	50 A		Richfield
Mason	Pentwater	26	17 N	18 W	15417	10-15-49	2,062	12 Oil 2 Wtr		Dundee
Ogemaw	Mio	4	24 N	2 E	15341	12-10-49	4,257			Richfield
Van Buren	Coffee Lake	18	1 S	15 W	14636	1-10-49	1,031	200 A		Traverse
Van Buren	Geneva	27	1 S	16 W	15443	10-3-49	1,044	50 A		Traverse

* 10 A (10 after acid)
** 70 N (70 Natural

SYSTEM, SERIES	FORMATION, GROUP	LITHOLOGY	THICKNESS	ECONOMIC PRODUCTS
RECENT				
PLEISTOCENE	GLACIAL DRIFT	SAND, GRAVEL, CLAY, boulders, marl	0-1000	SAND, GRAVEL, PEAT, MARL, FRESH WATER
"PERMO-CARBONIFEROUS"	"RED-BEDS"	SHALE, CLAY, SANDY SHALE, gypsum		
PENNSYLVANIAN	GRAND RIVER	SANDSTONE, sandy shale	80-95	BUILDING STONE, FRESH WATER
	SAGINAW	SHALE, SANDSTONE, limestone, coal	20-535	SHALE, COAL, FRESH WATER, BRINE, GAS
MISSISSIPPIAN	BAY PORT	LIMESTONE, SANDY OR CHERTY LIMESTONE, SANDSTONE	2-100	LIMESTONE, FRESH WATER
	MICHIGAN	SHALE, gypsum, anhydrite, sandstone	0-500	GYPSUM
	MICHIGAN "STRAY"	SANDSTONE	0-80	GAS
	MARSHALL	SANDSTONE, sandy shale	100-400	FRESH WATER, BRINE, BUILDING STONE
	COLDWATER	SHALE, sandstone, limestone	500-1100	SHALE, FRESH WATER
	SUNBURY	SHALE	0-140	
	BEREA-BEDFORD	SANDSTONE, SHALE	0-325	GAS, OIL
	ELLSWORTH-ANTRIM	SHALE, limestone	100-950	SHALE, GAS
DEVONIAN	TRAVERSE	LIMESTONE, SHALE	100-800	LIMESTONE, OIL, GAS, FRESH WATER
	BELL	SHALE, Limestone	0-80	SHALE
	ROGERS CITY-DUNDEE	LIMESTONE	0-475	LIMESTONE, OIL, GAS, FRESH WATER
	DETROIT RIVER	DOLOMITE, limestone, salt, anhydrite	150-1400	LIMESTONE, DOLOMITE, OIL, GAS, SALT, BRINE, FRESH WATER
	SYLVANIA	SANDSTONE, SANDY DOLOMITE	0-550	GLASS SAND, FRESH WATER
	BOIS BLANC	DOLOMITE, CHERTY DOLOMITE	0-1000	
SILURIAN	BASS ISLAND	DOLOMITE	50-570	DOLOMITE, FRESH WATER
	SALINA	SALT, DOLOMITE, Shale, anhydrite	50-4000	SALT, GAS, OIL
	NIAGARAN (Guelph-Lockport-Engadine) (Manistique-Burnt Bluff) (Cataract)	DOLOMITE, Limestone, shale	150-800	LIMESTONE, DOLOMITE, OIL, GAS, FRESH WATER
ORDOVICIAN	CINCINNATIAN (Richmond) (Maysville-Eden)	SHALE, LIMESTONE	250-800	
	TRENTON-BLACK RIVER	LIMESTONE, DOLOMITE	200-1000	OIL, GAS, LIMESTONE, FRESH WATER
	ST. PETER	SANDSTONE	0-150	FRESH WATER
OZARKIAN OR CANADIAN	PRAIRIE DU CHIEN	DOLOMITE, Shale	0-410	
	HERMANSVILLE	DOLOMITE, SANDY DOLOMITE, sandstone	15-500	
CAMBRIAN	LAKE SUPERIOR (Munising) (Jacobsville)	SANDSTONE	500-2000	BUILDING STONE, FRESH WATER
ALGONKIAN	KEWEENAW (Copper formations)	LAVA FLOWS, conglomerate, shale, sandstone	9800-35000	COPPER, SILVER, ROAD METAL, SEMI-PRECIOUS GEM STONES
	KILLARNEY GRANITE	GRANITE, GNEISS, diorite, syenite		
	HURONIAN (Iron formations)	SLATES, HEMATITE, SCHIST, QUARTZITE, GRANITE, marble, dolomite	2000+	IRON ORE, ROOFING SLATE, ROAD METAL, GRAPHITE, MARBLE
ARCHEAN	LAURENTIAN	SCHIST, GNEISS, GRANITE		ROAD METAL, BUILDING STONE, VERDE ANTIQUE, TALC, GOLD
	KEEWATIN	SCHIST, GREENSTONE, SLATE		ROAD METAL

GENERALIZED COLUMNAR SECTION OF MICHIGAN

MICHIGAN GEOLOGICAL SURVEY DIVISION

1949

FIG. 3

Oil And Gas Developments In The Rocky Mountain Region During 1949

By RAYMOND M. LARSEN, * Member AIME

GENERAL

The area covered by this paper is the same as from 1944 to 1948. The major activities were in Colorado, Montana, Utah, and Wyoming. Idaho, Nevada, North Dakota, and South Dakota are discussed briefly.

Total oil production in the four producing states was 81,228,000 bbl, as compared with 82,383,000 bbl in 1948. Production in Colorado increased 5,525,000 bbl, due to more runs from the Rangely Field through the pipe line to Salt Lake City which was completed in November, 1948. Utah had its first important production, mostly from the Ashley Creek and Roosevelt Fields. Montana production declined 246,000 bbl. Wyoming production declined 7,055,000 bbl, due to an increasing weakness in the low gravity black oil market.

Measured gas production, used or sold, increased from 92,057 Mcf in 1948 to 93,102 MMcf in 1949. Gross production increased from 128,695 MMcf to 145,174 MMcf, mainly because of greater oil production in the Elk Basin, Mush Creek, Fiddler Creek, Rangely, and Worland Fields.

Total drilling in the four states, based upon all drilling wells, declined from 1,529 wells and 4,697,187 ft of drilled hole in 1948 to 1,245 wells and 3,934,489 ft in 1949. Drilling in Colorado was considerably less than in the 1946-48 period, because development of the Weber Pool at Rangely to 40-acre spacing was nearly completed in 1948. Only in Utah did drilling activity increase.

New state drilling depths were established in unsuccessful wildcats for Montana at Ash Creek, for Utah at Thompson, and for Wyoming at Pacific Creek (world's deepest hole). The wells are listed in Table 2. The deepest well in Colorado, at Wilson Creek, was drilled to 12,702 ft in 1944-46.

Among the highlights of the year to influence future developments were the discovery of oil in Tertiary beds at Roosevelt, Utah, in the Uinta Basin, which followed the Pennsylvanian system discovery in 1948 at Ashley Creek; and the oil discovery at Gurley, Western Nebraska, in the Julesburg (Denver) Basin. Although the latter area is not included in this paper the overall outline of the basin extends into southeastern Wyoming, northeastern Colorado, and northwestern Kansas. A discovery in the Glenrock area and new pools in the Sussex area, both in the southern part of the Powder River Basin, stimulated interest in further drilling and exploration there, although they did not contribute much drilling or production during 1949.

Thirty-five unit agreements were approved by the U. S. Geological Survey in 1949, as compared with 40 in 1948. Three of them involved proven fields - Big Medicine Bow, La Barge and Seven Mile, all in Wyoming. The others represented wildcat blocks. Thirty-two agreements were terminated, the greatest number in any year to date. Unsuccessful exploratory wells had been drilled in the unitized areas. Since 1931, 261 unit agreements have been approved and 110 terminated, leaving 151 in effect on December 31, 1949.

Also of importance as to Department of the Interior relations with the oil industry, was the consolidation of Bureau of Land Management district land offices at major cities in three states. The Pueblo, Colorado, office was moved to Denver on June 17. The Great Falls, Montana office was moved to Billings on July 29. The Carson City, Nevada, office was moved to Reno on August 12. Consolidation of Wyoming offices at Cheyenne followed in January, 1950. Regional offices are located at Billings and Salt Lake City.

Prices of light crude oil remained generally steady throughout the year. The Mid-Continent price for 36° gravity light oil at Salt Creek was $2.57 per bbl. The price of 26° gravity Tensleep heavy crude there was reduced from $2.19 to $1.94 per bbl on May 16. Oregon Basin crude sold on a gravity basis until May 11, 22° gravity oil being $2.11 per bbl. On May 11 a flat price of $1.65 was posted. This was dropped to $1.40 on December 20. Somewhat similar changes affected other low gravity crudes, most of which are produced in the Big Horn Basin of Wyoming.

* PETROLEUM ENGINEER, U. S. GEOLOGICAL SURVEY, CASPER, WYOMING.

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Pipe line construction included a 75-mile, 8-inch oil line from Fiddler Creek via Mush Creek and Skull Creek to the Cheyenne-Denver and Freeman, Missouri, trunk lines at Lance Creek, Wyoming; a 68-mile, 12-inch oil line from Elk Basin and Silver Tip, Wyoming, replacing an older line to Laurel and Billings, Montana, and an 8-inch products line from Salt Lake City to Twin Falls, Idaho, with delivery points at Ogden, Utah, Burley and Twin Falls, Idaho. This line was continued in 1950 with 8-inch pipe to Baker, Oregon and 6-inch to the terminal point at Pasco, Washington. The total length of the line is 560 miles.

A major project announced, but on which only preliminary work was done, is a 340-mile, 12 3/4-inch gas line from Worland, Wyoming, to Cabin Creek, Montana, to make processed gas from the Worland Field available in the Howdoin-Cedar Creek system. With one compressor plant at Worland, this line will be able to handle 35 MMcf per day.

Shorter lines included a 10-mile, 6-inch gas line from Little Buck Creek and East Lance Creek to Lance Creek, Wyoming, to save and process oil-well gas; a 13-mile, 4-inch oil line from Gooseberry to Grass Creek, Wyoming; a 9-mile, 4-inch oil line from Reagan to Cut Bank, Montana; a 14-mile, 8-inch oil line from Sussex to Salt Creek, Wyoming; a 7-mile, 4-inch oil line from South Cole Creek, Wyoming, to the Cole Creek-Casper line; and a 21-mile, 6-inch gas line from the Utopia Field to Telstad, Montana.

COLORADO

Although several more exploratory wells were started in 1949 than in 1948 and previous years, the total number of drilling wells was down 42 per cent and footage was down 60 per cent. As said under general remarks, oil production increased and drilling decreased considerably, due to developments at Rangely. A natural gasoline plant in this field was placed in operation on December 4, 1948, and was producing gasoline, propane, and butane during 1949. Initial plant capacity was 20 MMcf, and recovery 25,000 gal per day. This is the first important production of natural gas liquids in the State. Of the 55 oil wells completed in Colorado in 1949, thirty-nine were shallow (Mancos shale) and nine were deep (Weber sandstone) wells in the Rangely Field.

Only two nominal discoveries were reported, oil at Oak Creek and gas at Asbury Creek (see Table 2). Three failures were recorded at Dove Creek, which dampened the prospects stimulated by the 1948 discovery there. Six important failures followed the Julesburg Basin discovery in Nebraska, and 13 failures were in northwestern Colorado, drilled partly because of the Oak Creek discovery. The Committee on Statistics of Exploratory Drilling of the American Association of Petroleum Geologists, whose classifications are slightly different and more detailed than the writer's, listed 50 exploratory completions in 1948, with 10 successful; and 52 in 1949, with the above two successful. Outpost wells are included in its summaries.

Seismograph activity decreased 17 per cent from 1948, from 77 to 64 crew months, according to one source of information. Most of this activity was in the Julesburg Basin.

The following Table A and similar tables for other producing states, are repeated and extended to furnish a reference for the 10-year period 1940-49, before, during, and after World War II. Wildcat wells are listed in Table 2, and field data in Table 1.

The information in these tables has been compiled from U. S. Geological Survey records and previous papers. Production figures may be revised from time to time as field totals are adjusted. Metered or marketed gas production is measured gas produced for sale or regular use. Gross gas production includes also recycled gas, but not CO_2 gas or stored gas, and estimates of gas used or lost in oil and gas fields, according to the definition of the U. S. Bureau of Mines in the Natural Gas Chapter of the Minerals Yearbooks. Most of the gas production figures in Table 1 are metered or marketed gas, at the pressure base of 15.025 psi in use for measurements in the region.

TABLE A - DRILLING AND PRODUCTION, COLORADO

YEAR	WILDCAT WELLS STARTED	NUMBER OF WELLS DRILLING	TOTAL DRILLING FOOTAGE	OIL WELLS COMPLETED	ANNUAL OIL PRODUCTION (Bbl.)	GAS WELLS COMPLETED	METERED OR MARKETED GAS *	GROSS GAS PRODUCTION *
1940	16	64	78,548	15	1,721,849	1	2,082	2,146
1941	9	61	102,848	14	2,137,954	4	2,713	2,887
1942	9	55	109,125	12	2,232,961	1	4,030	4,387
1943	12	78	118,364	16	2,337,268	1	5,460	6,148
1944	11	94	246,165	31	3,113,946	0	4,872	5,987
1945	21	134	512,246	51	5,024,357	3	4,247	5,860
1946	24	228	1,181,427	167	11,928,565	2	4,941	8,702
1947	52	336	1,368,772	187	15,808,955	3	6,030	10,816
1948	47	324	1,094,967	159	18,055,569	11	6,490	9,374
1949	53	188	438,701	55	23,580,369	4	6,063	13,819

* Millions of cubic feet

IDAHO

Drilling on the Big Elk Mountain structure commenced in December, 1949, in Sec. 23, T. 2 S. R. 44 E., Bonneville County, under a farmout detail from Sinclair Oil and Gas Co. to Sun Oil Co., but was suspended for the winter at 125 ft. Phillips Petroleum Co. and Utah Southern Oil Co. were making preparations to drill their Juniper block in Sec. 10, T. 14 S., R. 30 E., Oneida County. These tests have Pennsylvanian and lower objectives. Several other tests were scheduled for 1950.

About 41 wells have been drilled seeking oil and gas in Idaho. Most of these were shallow holes drilled by local companies prior to 1933. Some gas was found in the lacustrine Payette formation. The only previous test well in the State drilled by a major oil company was the 3,780-ft hole of The California Co. at Ririe or Meadow Creek in Bonneville County drilled in 1930.

MONTANA

Total drilling activity and footage in 1949 was about 80 per cent of 1948, although nine more exploratory wells were started. Oil well completions dropped from 190 to 140 wells. Oil production declined slightly from the 1948 maximum. Cut Bank was still the largest producer, although the decline there was 637,000 bbl. Elk Basin (Montana side) was second, and Kevin-Sunburst third in rank.

New discoveries were made at Sumatra, Devil's Pocket, and Jack Creek, but their importance was not confirmed during the year. Other successful exploratory wells are classified as deeper pool tests or outposts in Table 2. The CSED listed 57 exploratory wells completed in 1948, with 14 successful, and 66 in 1949, with 12 successful. Seismograph activity increased from 58 to 163 crew months.

The new Carter Oil Co. refinery at Billings, with a capacity of 20,000 B/D, was formally placed in operation on August 26. A new Continental Oil Co. refinery with a capacity of 8,000 B/D, was completed in the same city. These refineries are served by the Elk Basin pipe line previously mentioned. A plant to remove sulphur from the Madison lime gas in the Beagan Field was placed in operation on October 25, 1949. The plant is in the North Cut Bank Field, and later, Madison lime gas from the pools there was treated, eliminating flaring of this sour gas.

NEVADA

Only one well was drilling during the year. The United Petroleum Corp. well at Apex in Clark County (Sec. 6, T. 18 S, R. 64 E.) was continued from 900 to 1,241 ft and still drilling. About 34 wells have been drilled for oil and gas in Nevada, mostly by small operators to shallow depths. More important activities were expected in 1950.

NORTH DAKOTA

Three small gas wells were completed by Montana-Dakota Utilities Co. near the southern end of the Cedar Creek anticline. A stratigraphic test by the Continental and Pure Oil companies northeast of Bismarck in Burleigh County (Sec. 6, T. 140 N., R. 77 W.) was drilled to 6,957 ft in Devonian sediments and abandoned. The Red River Oil Co. drilled to the pre-Cambrian at 1,665 ft in Grand Forks County (Sec. 35, T. 151 N., R. 52 W.). The Price Drilling Co. well at Carpio in Ward County (Sec. 16, T. 157 N., R. 85 W.) was continued at 8,485 ft with major company assistance and abandoned, probably in Ordovician sediments. The Union Oil Co. well near Devil's Lake in Ramsey County (Sec. 29, T. 158 N., R. 62 W.) was abandoned at 3,325 ft in pre-Cambrian rocks.

Sixty-five oil and gas tests have been drilled in the State to date, of which 28 are gas wells in the Cedar Creek Field and several wells have been abandoned there. Gas production is given in Table 1. The recent drilling was influenced by possibilities of Devonian reef accumulation similar to conditions in Alberta, Canada.

SOUTH DAKOTA

Three wells were drilled and abandoned, one was suspended, and two were still drilling, as follows:

OPERATOR	LOCATION	AREA	COUNTY	DEPTH	STATUS
E. Kucera	19-3N-7E		Meade	1,378	Susp
E. Kucera	19-3N-7E		Meade	1,828	Drg
Wm. Seyler	12-8N-5E	Two Top	Butte	5,710	Drg
Palensky Bros.	25-4S-7E	Fairburn	Custer	3,136	Abd
Palensky Bros.	10-6S-6E	Buffalo Gap	Custer	992	Abd
Pacific Western	10-11S-1E	Wallace	Fall River	4,080	Abd

TABLE B - DRILLING AND PRODUCTION, MONTANA

YEAR	WILDCAT WELLS STARTED	NUMBER OF WELLS DRILLING	TOTAL DRILLING FOOTAGE	OIL WELLS COMPLETED	ANNUAL OIL PRODUCTION (BBL)	GAS WELLS COMPLETED	METERED OR MARKETED GAS *	GROSS GAS PRODUCTION *
1940	20	297	555,051	151	6,709,430	49	25,444	25,604
1941	24	332	620,752	163	7,523,823	59	27,319	27,484
1942	12	265	464,858	123	8,072,610	69	29,910	31,012
1943	57	373	680,145	158	7,899,415	51	30,325	31,597
1944	46	497	1,030,544	219	8,625,511	81	31,549	33,175
1945	26	407	795,858	223	8,406,841	49	31,064	32,344
1946	49	391	684,121	145	8,817,546	83	31,136	33,147
1947	51	415	749,709	166	8,744,189	92	33,013	38,235
1948	54	408	760,828	190	9,356,392	48	34,725	40,617
1949	63	325	631,924	140	9,126,110	65	35,481	41,779

* Millions of cubic feet

Eighty-eight oil and gas tests have been drilled in the State to date. Five of these are gas-water wells at Pierre, and six are low pressure shut-in gas wells at Ardmore. These "fields" are listed in Table 1.

Seismograph activity in the Dakotas, not separated, increased from nine crew months in 1948 to 53 in 1949.

UTAH

The number of drilling wells and footage drilled established an all time record for the State, although two less wildcats were started than in 1948. Two oil wells were completed at Ashley Creek in 1948, and 25 in 1949, which nearly completed the development of this small but prolific pool. Two oil wells were completed in the shallow zone at Boundary Butte. An oil discovery in Tertiary deposits at Roosevelt sparked interest in further exploration of the Uinta Basin. This discovery well produced at the rate of 400 to 600 B/D the first six months. Testing was completed at the Upper Valley well in southern Utah, and it was suspended as probably non-commercial. No gas wells were drilled.

The CSED listed 17 exploratory wells completed in 1948, with five successful; and 26 in 1949, with two successful. Seismograph activity increased from 17 crew months in 1948 to 45 in 1949.

Although 200,000 bbl of oil were produced from the small Virgin and San Juan fields commencing in 1907, and a small amount from the Ashley Creek and Boundary Butte fields in 1948, the first important oil production in the State began in 1949. Commercial gas production, as in years past, was confined to Clay Basin and the Farnham CO_2 field.

WYOMING

On the basis of Table E, wildcat starts and drilling wells showed a slight decrease in 1949 compared to 1948. On the basis of well completions, activities could be considered about the same, or slightly higher in 1949. Between 570 and 600 wells were completed in each of the two years, according to various counts. The writer's figures indicate 64 fewer oil wells and 88 more dry holes completed in 1949 than in 1948. Due to the fact that many wells are carried as suspended it is not practicable to distinguish completions from temporarily, seasonally, or indefinitely suspended wells.

The CSED reported 147 exploratory wells drilled in 1948, with 44 successful; and 191 in 1949, with 40 successful. Only 30 wells are listed as successful exploratory wells in Table 2. The number of deeper pool tests was much less than in 1948. Seismograph activity declined from 490 crew months in 1948 to 420 in 1949, or 14 per cent, increasing only in the Wind River Basin. About 12 per cent of this activity was in the Big Horn Basin, 29 per cent in the Wind River Basin, 12per cent in the Green River Basin, 42 per cent in the Powder River Basin, and five per cent miscellaneous.

New field discoveries were at Borie, Glenrock, Hay Creek, Lake Creek, Lightning Creek, Little Sand Draw, Lodgepole, Lonetree Creek, Murphy Dome, North Meadow Creek, Riverton, Sage Spring Creek, Salt Wells (gas), and South Frisby, a total of 14, as compared with the 17 listed in the 1948 report. Deeper tests proved the Tensleep sandstone to be productive of oil at Beaver Creek and Golden Eagle, and the Leo Zone at Little Buck Creek. These and other important exploratory wells are detailed in Table 2.

About 50 per cent of the oil wells and dry holes drilled in the State in 1949 were in Weston County, in the Mush Creek, Skull Creek and Fiddler Creek Fields, the Hay Creek, Lodgepole, and Lonetree Creek new discovery areas, and at outlying locations. Oil well completions in the four counties of the Big Horn Basin dropped from about 155 in 1948 to 80 in 1949, because of the weakness of the black oil market. In fact, oil well completions were fewer in all counties, except Johnson, Laramie, Washakie, and Weston.

Elk Basin (all pools, Wyoming side only) retained first place in oil production in 1949, followed by Salt Creek. Lost Soldier displaced Steamboat Butte in third place, and Worland displaced Oregon Basin in fourth place. Lance Creek remained in fifth place, as it was in 1948.

The following tabulation "D" compares the 1948 and 1949 production in the 16 fields which produced more than 1,000 000 bbl during either year from all zones and pools. The decline in production of some of the black oil fields, and the new production from the Fiddler Creek and Worland Fields is very noticeable.

TABLE C - DRILLING AND PRODUCTION, UTAH

YEAR	WILDCAT WELLS STARTED	NUMBER OF WELLS DRILLING	TOTAL DRILLING FOOTAGE	OIL WELLS COMPLETED	ANNUAL OIL PRODUCTION (BBL)	GAS WELLS COMPLETED	METERED OR MARKETED GAS *	GROSS GAS PRODUCTION *
1940	1	9	14,208	0	3,275	2	4,301	4,346
1941	1	8	8,063	0	3,635	1	4,705	4,724
1942	5	6	11,807	0	1,685	0	4,384	4,390
1943	6	9	22,066	0	x	0	3,865	3,893
1944	2	9	7,535	0	x	0	6,203	6,223
1945	10	17	21,582	1	100	1	6,652	6,671
1946	13	24	41,556	0	500	1	4,295	4,321
1947	15	35	52,777	1	700	1	6,036	6,064
1948	21	39	98,640	4	16,451	4	6,610	6,633
1949	19	61	238,216	29	632,354	0	6,126	6,338

* Millions of Cubic feet.

TABLE "D" - MAJOR FIELD PRODUCTION, WYOMING, 1948-1949

	1948 - Bbl	1949 - Bbl
Big Sand Draw	2,590,310	2,214,832
Byron	2,242,729	1,440,664
Elk Basin	5,250,561	5,322,697
Fiddler Creek	11,980	1,258,379
Frannie	1,669,017	1,304,853
Garland	2,002,561	1,186,761
Hamilton Dome	3,128,320	1,491,081
Lance Creek	3,247,131	2,789,527
Little Buffalo Basin	1,243,093	594,016
Lost Soldier	3,050,392	3,245,572
Mush Creek - Skull Creek	1,270,011	1,707,272
Oregon Basin	3,485,823	1,600,606
Salt Creek	4,647,668	3,939,010
Steamboat Butte	3,753,968	2,219,054
Wertz	2,229,315	1,894,735
Worland	1,576,108	3,084,461
Total from 16 fields	41,398,987	35,293,520
Total State	54,927,473	47,884,053

Stanolind Oil and Gas Co., as unit operator of the Elk Basin Field, placed a combination repressuring, gasoline and sulphur extraction plant in partial operation in March 1949, and operation in all phases in October. The intake capacity is 12 MMcf per day, composed of eight per cent inert gases, 18.5 per cent H_2S, and 73.5 per cent hydrocarbons. The plant has a productive capacity of 56,200 gallons of gasoline, butane, and propane, 4.2 MMcf of marketable natural gas which is delivered to the Billings pipe line system, 14MMcf of inert gas which is compressed to 1,500 psia and returned to the Tensleep sandstone for pressure maintenance, and 74 long tons of sulphur per day. Sufficient water and natural gas were not available economically for secondary recovery operations, the gas produced with the oil was not marketable and was flared prior to completion of the plant. This resulted in complaints about the hydrogen sulphide gas in the atmosphere.

Pure Oil Co., as unit operator, was constructing a gasoline recovery plant, and Texas Gulf Sulphur Co., a sulphur extraction plant, in the Worland Field, which were nearing completion at the end of 1949. About 43MMcf per day of sour gas, containing 30 per cent H_2S, was burned and flared in the field in 1949 to avoid the toxic effects of the gas. The burning of the gas created 291 cu ft of sulphur dioxide and 806 cu ft of carbon dioxide per 1,000 cu ft of field gas. The flared gas seemed to have an injurious effect on certain agricultural plants in the fertile valley and caused complaints. Drilling was curtailed the latter part of the year until the recovery plants could be completed and unitization of all producing tracts attained, which was finally effected on May 1, 1950. The sweet gas will be sold through the new Worland - Cabin Creek pipe line of the Montana-Wyoming Gas Pipe Line Co. and the Montana-Dakota Utilities Co., Bowdoin-Cedar Creek system in Eastern Montana and the western Dakotas. The sulphur plant will extract about 300 tons of sulphur per day from 30 MMcf of gas.

Both of these projects are major conservation measures to make the extremely sour gas in these large fields usable, to maintain pressure in the oil-producing formations, and to produce a quantity of pure sulphur from the gases.

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TABLE E - DRILLING AND PRODUCTION, WYOMING

YEAR	WILDCAT WELLS STARTED	NUMBER OF WELLS DRILLING	TOTAL DRILLING FOOTAGE	OIL WELLS COMPLETED	ANNUAL OIL PRODUCTION (Bbl)	GAS WELLS COMPLETED	METERED OR MARKETED GAS *	GROSS GAS PRODUCTION *
1940	31	233	496,005	122	25,906,481	4	26,645	38,943
1941	24	202	489,884	111	30,332,819	8	28,317	43,409
1942	16	179	483,025	106	32,855,795	6	30,029	46,471
1943	38	227	621,936	102	34,230,711	5	31,920	48,476
1944	52	316	961,559	177	33,241,581	6	35,999	51,602
1945	54	320	987,173	151	36,265,710	13	36,357	51,673
1946	51	258	791,639	127	38,981,379	13	33,759	49,568
1947	69	396	1,287,800	188	44,739,943	14	39,512	57,740
1948	170	758	2,742,752	388	54,927,473	10	44,233	72,072
1949	154	671	2,625,648	324	47,884,053	11	45,432	83,238

* Millions of Cubic feet.

TABLE I - OIL AND GAS PRODUCTION STATISTICS FOR COLORADO DURING 1949

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl	
				AREA PROVED ACRES	BARRELS TO END OF 1949	BARRELS DURING 1949	AREA PROVED ACRES	MILLION CU FT[c] TO END OF 1949	MILLION CU FT[c] DURING 1949		TO END OF 1949	DURING 1949
1	Arikaree (Bray), *Yuma*	Niobrara *	1919	0			0x	(F)	(F)			
2	Asbury Creek, *Mesa*	Dakota *	1949	0			160	(F,L) 5	S I			
3	Barker Creek [11], *La Plata*	Paradox *	1948	0			3,000	0	S I			
4	Bell Nook, *Moffat*	Iles *	1930	0			160x	Abd [2]	0			
5	Berthoud, *Larimer*	Totals			79,319	2,265		1,030	35			
6	Berthoud, *Larimer*	Niobrara, etc. *	1927	0			320	1,030	35			
7	Berthoud, *Larimer*	Muddy	1929	200	79,319	2,265	0					
8	Black Canyon, *Delta*	Morrison, Entrada * x	1917				550	(CO_2) 0	0			
9	Boulder, *Boulder*	Pierre	1901	400	722,817	7,260	0					
10	Chromo, *Archuleta*	Mancos	1947	80	15,706	7,100	0					
11	Clark Lake, *Larimer*	Muddy	1944	200	325,748	29,237	0					
12	Craig (Breeze), *Moffat*	Iles, Morapos *	1932	0			160	209	-3			
13	Delhegue, *Mesa*	Mesaverde	1902	0	Non-Com.	Abd	0					
14	Douglas Creek, *Rio Blanco*	Dakota-Lakota *	1943	0			960	0	S I			
15	Dove Creek, *Montezuma*	Paradox *	1948	0	(C)	(C)	160	(F,L) 148			x	x
16	Elk Springs, *Moffat*	Weber	1946	80	153,468	57,512	0					
17	Florence-Canon City, *Fremont*	Pierre 1863-	1876	9,000x	14,011,058	23,385	0					
18	Fort Collins, *Larimer*	Muddy, Dakota	1924	520	2,597,765	31,166	0	(F)	(F)			
19	Garcia, *Las Animas*	Pierre, Niobrara *	1898	0			1,500x	1,561x	Abd			
20	Garmesa, *Garfield*	Dakota, Entrada *	1925	0			520	High CO_2	S I			
21	Gray's (Price) *Archuleta*	Dakota	1935	127	3,184,193x	164,253x	0					
22	Greasewood, *Weld*	Muddy	1930	300	518,622	8,198	0					
23	Hiawatha, E. [11] *Moffat*	Wasatch * (gas)	1926	0	(C)	(C)	3,500	34,339	2,476 [11]		x	x
24	Hiawatha, E. [11] *Moffat*	Wasatch (oil)	1934	320	1,060,067	61,371 [2]	0					
25	Hiawatha, W., *Moffat*	Totals						11,397 [11]	641			
26	Hiawatha, W., *Moffat*	Wasatch *	1929	0	(C)	(C)	1,200	11,398	631		x	x
27	Hiawatha, W., *Moffat*	Fort Union *	1948	0			400	16	10			
28	Iles, *Moffat*	Totals			13,037,404	522,657 [2]						
29	Iles, *Moffat*	Mancos	1925	30	136,604	674	0					
30	Iles, *Moffat*	Morrison	1927	920	1,119,123	53,231	0	(F) 224	(F)			
31	Iles, *Moffat*	Entrada	1927	600	11,259,023	474,957	0	(F) 1,126	(F)			
32	Mancos River, *Montezuma*	Mancos	1927	300x	5,797	Abd	0					
33	Maudlin Gulch, *Moffat*	Totals			59,299	55,110						
34	Maudlin Gulch, *Moffat*	Morrison	1947	400	20,411	18,534	0					
35	Maudlin Gulch, *Moffat*	Entrada	1948	400	38,888	36,576	0					
36	McCallum, North, *Jackson*	Dakota	1926	1,400	982,701	120,169	0	CO_2 w/oil				
37	McCallum, South, *Jackson*	Dakota	1928	40x	22,089	S I	0	CO_2 w/oil				
38	McElmo, *Montezuma*	Totals						0	0			
39	McElmo, *Montezuma*	Shinarump *	1948	0			320	(F)	(F)			
40	McElmo, *Montezuma*	Ouray	1948	0			160	(CO_2)	S I			
41	Model Dome, *Las Animas*	Lyons *	1927	0			5,200x	53	S I	(Helium Gas)		
42	Moffat, *Moffat*	Totals			6,634,028	84,145 [2]		(F)	(F)			
43	Moffat, *Moffat*	Dakota	1924	215	4,721,248	12,428	0					
44	Moffat, *Moffat*	Morrison	1927	40	10,934	4,947	0					
45	Moffat, *Moffat*	Entrada	1927	320	2,236,565	66,770	0					
46	New Raymer, *Weld*	Dakota *	1933	0			40	(F)	Abd			
47	Oak Creek, *Routt*	Shinarump	1949	40	9,143	9,143	0					
48	Pagoda, *Routt*	Shinarump *	1948	0			760	(F,L) 17	S I			
49	Piceance Creek, *Rio Blanco*	Green River *	1930	0			6,920	(F) 78	S I			
50	Point Lookout, *Montezuma*	Dakota *	1930	0			1,720	(F) 23	(F)			
51	Powder Wash, *Moffat*	Totals			397,779	63,347 [2]		16,762	2,545 [2]			
52	Powder Wash, *Moffat*	Wasatch * 1931-	1936	700	403,075	64,545	2,440	16,864	2,538		x	x
53	Powder Wash, *Moffat*	Fort Union *	1949	100	199	199	100	15	15			
54	Rangely, *Rio Blanco*	Totals			57,222,815	19,633,530		(F,L) 18,388	(F,L) 6,770			
55	Rangely, *Rio Blanco*	Mancos	1902	2,760	3,483,305	354,759	0					
56	Rangely, *Rio Blanco*	Shinarump	1946	40	120,882	19,968	0					
57	Rangely, *Rio Blanco*	Weber	1933	19,200	53,618,628	19,258,803	0	(F,L) 18,288	(F,L) 6,770			
58	Red Mesa, *La Plata*	Mesaverde, Dakota	1924	120x	6,355	Abd	0	(F)	0			
59	Thornburg, *Moffat and*							2,542	364			
60	Thornburg, *Rio Blanco*	Dakota *	1925	0			937	2,112	306			
61	Thornburg, *Rio Blanco*	Entrada *	1927	0			526	430	58			
62	Tow Creek, *Routt*	Mancos	1925	400	2,085,053	47,689	0	(F)	(F)			
63	Wellington, *Larimer*	Dakota	1923	1,920	5,449,391	65,514	0	(F)	(F)			
64	White River, *Rio Blanco*	Wasatch * 1917-	1930	0			646x	526x	S I			
65	Wilson Creek, *Rio Blanco*	Totals			15,902,157	2,587,321		(F,L) 2,818	(F,L) 270			
66	Wilson Creek, *Rio Blanco*	Morrison	1938	2,843	8,659,094	1,308,138	0					
67	Wilson Creek, *Rio Blanco*	Entrada	1941	980	7,243,063	1,279,183	0					
68		Total Colorado		39,730	124,444,774	23,580,369	31,007	91,035+	13,529		116,665	26,631

LINE NUMBER	NUMBER OF WELLS[e]			WELLS PRODUCING[f] DEC. 1949			RESERVOIR PRESSURE LB. PER SQ. INCH		SECONDARY RECOVERY[g]	CHARACTER OF OIL[h]		PRODUCING FORMATION					DEEPEST ZONE TESTED[n] TO END OF 1949	
	COMPLETED TO END 1949	1949		OIL		GAS	INITIAL	AVG. /END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT.[k]	PROD. THICKNESS AVG. FT. / NET	STRUCTURE[m]	NAME	DEPTH OF HOLE, FT.
		COMPLETED	ABANDONED	FLOWING	ARTIFICIAL LIFT													
1	6	0	0	0	0	2	400±	±				Shs		1,565	15	D	Pre-Camb.	5,595
2	1	1	0	0	0	0			U			S		2,836	40	D	Pre-Camb.	4,223
3	2	1	0	0	0	0	2,945	2,945				L		9,290	100	D	Paradox	9,654
4	2	0	0	0	0	0	1,050					S		2,853	15	D F	Entrada	9,084
5	6	0	0	0	1	2										D	Morrison	3,966
6	4	0	0	0	0	2	1,310					Shs		2,940	15			
7	2	0	0	0	1	0				39	-.1	S		3,765	5*			
8	4	0	0	0	0	0	40±					S		385	50	D	Pre-Camb.	685
9	60±	0	0	0	3	0				42	-.1	S		2,500	Var.	A	Dakota	6,145
10	9	3	1	0	8	0				32	-.2	Sh		580	5*	A	Pre-Camb.	1,625
11	5	0	0	0	5	0				38	.2	S		5,940	50	A	Sundance	6,530
12	3	0	0	0	0	3	1,365					S		2,740	30	A F	Mancos	3,880
13	6±	0	0	0	0	0				38		S		615		A	Mancos	3,542
14	3	0	0	0	0	0	1,380	1,380	U			S		4,390	70	D F	Morgan	8,558
15	1	0	0	0	0	0	2,575			48[c]		L S		5,910	24	D	Leadville	8,286
16	3	0	0	0	3	0	2,200			31	1.4	S		6,240	35	D	Weber	7,032
17	535±	0	0	0	71	0				30	-.1	Sh		1,000±	Var.	M T	Dakota	4,545
18	18	0	0	0	8	0				32	.1	S		4,690	70-27	D	Lykins	5,206
19	11	0	0	0	0	0						Shs		700±	Var.	A	Fountain	2,500
20	4[d]	0	0	0	0	0	825±		U			S		2,830±	40	D	Wingate, Pre-Camb.	4,342
21	18±	0±	0	0	16±	0				32	.4	S		1,150	150	A f	Morrison	1,752
22	5	0	0	0	2	0	1,500			42	-.1	S		6,675	25	A f	Morrison	7,042
23	10	0	0	0	0	7	1,100	Var.				S		2,240	35	D	Mesaverde	7,577
24	8	0	0	0	6	0				37	-.1	S		to 3,700	35			
25	6	0	0	0	0	5										D	Fort Union	4,601
26	5	0	0	0	0	4	850-1,500	470-1300				S		2,100±	37			
27	1	0	0	0	0	1	1,700	1,340				S		4,100	30			
28	38	0	4	0	23	0			U							D f	Madison	7,487
29	3	0	3	0	0	0				32	-.1	Sh		2,575	50			
30	6	0	0	0	4	0				33	-.1	S		3,200	50			
31	29	0	1	0	19	0	1,425			32	.5	S		3,300	50			
32	11	0	0	0	0	0				34	.2	Sh		250±	Var.	M T	Morrison	978
33	4	2	0	0	4	0			U							D	Entrada	6,842
34	1	0	0	0	1	0	1,400			36	-.4	S		6,060	114			
35	3	2	0	0	3	0	2,000			37	.3	S		6,550	12			
36	10	0	0	4	0	0[4]	2,400	2,238	U P.	46	-.1	S		5,365	25	A	Morrison	5,388
37	1	0	0	0	0	0	2,200		U	42	-.1	S		4,962	20	A	Morrison	5,708
38	2	0	0	0	0	0										D	Ignacio	7,099
39	1	0	0	0	0	0	50					L S		1,515	30			
40	1	0	0	0	0	0	800					L		6,805	160			
41	6	0	0	0	0	0	12-15					S		965	15	D	Fountain	2,010
42	16	0	0	0	11	0										D	Entrada	4,852
43	7	0	0	0	4	0	1,380±			40	-.1	S		3,850	25			
44	1	0	0	0	1	0	1,520±	1,025		39	-.1	S		4,230	50			
45	8	0	0	0	6	0	1,600±			38	-.1	S		4,550	50			
46	1	0	0	0	0	0	1,800					S		6,690	6	M H	Morrison	7,005
47	1	1	0	0	1	0	2,100			38	.2	S		6,670	25	A	Moenkopi	7,135
48	2	1	0	0	0	0	1,250	1,250	U			S Cg		3,925	40	D	Weber	4,900
49	6	0	0	0	0	0	800	800	U			S		3,060	20	D	Mesaverde	12,029
50	5	0	0	0	1	1	45±		U			S Cg		680	90	M	Morrison	920
51	16	1	0	6	1	7[5]			U							D M L	Fort Union	6,058
52	15	0	0	5	1	7	625-1,700	1,110-1550		45	-.1	S		2,130-5,130	20			
53	1	1	0	1	0	0	1,850	1,850		40	.1	S		5,360	25			
54	662	48	6	151	402	1										D f	Morgan	7,173
55	181	39	6	0	97	1				42	-.1	Sh		530*	Var.			
56	1	0	0	0	1	0	2,400			39	.5	S		5,955	20			
57	400	9	0	151	304	0	2,750	1,691		35	.7	S		6,150	150			
58	5	0	0	0	0	0				42		S		700-3,430		D	Morrison	3,844
59	3	0	0	0	0	3										D	Entrada	3,110
60	2	0	0	0	0	2	725	620				S		2,025	30			
61	1	0	0	0	0	1	900	885				S		2,570	50			
62	17	0	0	0	5	0				35	-.1	Sh		2,585	Var.	D	Pre-Cambrian	5,310
63	31	0	0	0	11	1	1,250			35	-.1	S		4,400	70	D	Lykins	5,000
64	7	0	0	0	0	0	1,700		U			Shs		500-5,500	15	D	Mesaverde	7,005
65	32	1	0	9	22	0			U							D	Sawatch	12,792
66	15	0	0	9	5	0	1,825	1,686	P	49	-.1	S		6,366	25			
67	17	1	0	0	17	0	2,080	1,975		48	-.1	S		6,785	30			
68	1,602	59	11	170	603	32												

TABLE I - OIL AND GAS PRODUCTION STATISTICS FOR MONTANA DURING 1949

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION (Thousands of Bbl)	
				AREA PROVED ACRES	BARRELS TO END OF 1949	BARRELS DURING 1949	AREA PROVED ACRES	MILLION CU FT[c] TO END OF 1949	MILLION CU FT[c] DURING 1949		TO END OF 1949	DURING 1949
1	Ajax, *Toole*	Colorado *	1946	0			640	(F)	(F)			
2	Amelia (Cane Butte) *Fergus*	Kootenai *	1924	0			440	(F,L) 15	S.I.			
3	Bannatyne, *Teton*	Ellis (Bowdoin Sd)	1927	960	55,245	0	0					
4	Bears Den, *Liberty*	Totals			54,676	2,837						
5	Bears Den, *Liberty*	Colorado *	1923	0			640	(F)	(F) 0			
6	Bears Den, *Liberty*	Kootenai *	1927	80	54,676	2,837	1,200	0	0			
7	Bears Den, *Liberty*	Ellis *	1945	0			960	0	0			
8	Bears Den, *Liberty*	Madison *	1947	0			640	0	0			
9	Berthelote, *Toole*	Colorado-Kootenai	1929-1930	40	15,232	931	160	(F)	(F)			
10	Big Wall, *Musselshell*	Amsden	1948	280	227,367	224,874	0					
11	Border, Red Coulee [e] *Toole*	Kootenai	1929	480	970,638	16,869	0					
12	Box and Arrow, *Toole*	Kootenai *	1935	0			640	50	Abd			
13	Bowdoin, *Phillips, Valley*	Colorado *	1912	0			120,400	52,681	8,077			
14	Bowes, *Blaine*	Totals			1,729	1,729		13,432	1,141			
15	Bowes, *Blaine*	Eagle *	1924				5,440	13,432	1,141			
16	Bowes, *Blaine*	Ellis	1949	40	1,729	1,729	0					
17	Boxelder, *Blaine, Hill*	Eagle *	1916	0			1,480	6,599	140			
18	Brady, *Pondera*	Kootenai	1943	80	2,617	891	0					
19	Cassady, *Hill*	Eagle *	1947	0			160	(F)	(F)			
20	Cat Creek, *Garfield, Petroleum*	Totals			17,146,499	459,791						
21	Cat Creek, *East Dome*	Ellis	1946	280	535,506	130,545	0					
22	Cat Creek, *Mosby Dome*	Colorado-Kootenai	1920	150	x	185,736	0					
23	Cat Creek, *Mosby Dome*	Morrison-Ellis	1945	300			0					
24	Cat Creek, *West Dome*	Colorado-Kootenai	1920	760	x	143,510	0					
25	Cat Creek, *West Dome*	Morrison-Ellis	1946	80			0					
26	Cedar Creek Fallon [e] *Wibaux*	Totals			31,678	2,270		127,743	2,289			
27	Cedar Creek	Judith River *	1914	0			90,400	120,512	1,236			
28	Cedar Creek	Eagle *	1916	0			43,000	7,231	1,053			
29	Cedar Creek	Mus, Ord	1936	60	31,678	2,270	0					
30	Clark Fork, *Carbon*	Totals			7,947	0						
31	Clark Fork, *Carbon*	Frontier	1944	0x	7,947	Abd	0					
32	Clark Fork, *Carbon*	Dakota *	1949	0	(C)	(C)	40	0	S.I.		0	0
33	Conrad-Midway, *Pondera*	Kootenai	1942	80	3,094	0	0					
34	Cut Bank, *Glacier, Toole*	Totals			63,547,169	3,436,516		203,858	18,796			
35	Cut Bank, *Glacier, Toole*	Kootenai	1926-1931	30,300	61,872,834	2,881,519	68,080	203,858	18,796			
36	Cut Bank, *Glacier, Toole*	Madison	1945	2,100	1,674,345	554,997	160	x	x			
37	Devils Basin, *Musselshell*	Big Snowy	1919	160	20,422	0	0					
38	Devils Pocket, *Musselshell*	Amsden *	1949	0			40	0	S.I.			
39	Devon, *Toole*	Totals			9,232	0		3,099	312			
40	Devon, *Toole*	Colorado *	1929	0			9,600	3,099	312			
41	Devon, *Toole*	Madison	1945	60	9,232	0	0					
42	Dry Creek, *Carbon*	Totals			2,837,400	108,710		18,903	1,736			
43	Dry Creek, *Carbon*	Frontier *	1929	0			1,880	18,903	1,736			
44	Dry Creek, *Carbon*	Cloverly	1930	720	2,827,400	108,710	0					
45	Elk Basin [e] *Carbon*	Totals			9,657,994	1,966,318						
46	Elk Basin, *Carbon*	Frontier	1915	100	955,403	18,390	0					
47	Elk Basin, *Carbon*	Tensleep	1943	1,375	7,946,313	1,476,515	0	(F,L)	(F,L)			
48	Elk Basin, *Carbon*	Madison	1947	940	756,278	491,613	0					
49	Elk Basin, N.W., *Carbon*	Totals			852,217	351,296						
50	Elk Basin, N.W., *Carbon*	Frontier	1947	160	423,066	195,895	0					
51	Elk Basin, N.W., *Carbon*	Lakota *	1948	0	(Small oil well converted to gas)		40					
52	Elk Basin, N.W., *Carbon*	Madison	1947	350	429,151	155,401	0					
53	Flat Coulee, *Liberty*	Totals			14,260	792		0	0			
54	Flat Coulee, *Liberty*	Colorado *	1947	0			640	0	0			
55	Flat Coulee, *Liberty*	Kootenai	1928	80	14,260	792	0					
56	Fraunie [e] *Carbon*	Tensleep	1940	20	178,639	18,037	0					
57	Fred & George Cr., *Toole*	Colorado *	1942	0			640	0	0			
58	Gage, *Musselshell*	Amsden	1943	640	381,024	18,987	0					
59	Grandview, *Liberty*	Kootenai *	1930	0								
60	Gunn, *Phillips*	Eagle *	1931	0			160					
61	Hardin, *Big Horn*	Frontier *	1913	0			4,000	1,558	113			
62	Havre, *Hill*	Eagle *	1914	0			160	725	10			
63	Haystack Butte, *Liberty*	Colorado *	1941	0			640	448	-1			
64	Ingomar, *Rosebud*	Amsden *	1943	0			0x	0 (CO_2)	Abd.			
65	Jack Creek, *Carbon*	Dakota	1949	40	360	360	0					
66	Kevin-Sunburst, *Toole*	Totals			53,089,338	1,557,933		64,765	1,943			
67	Kevin-Sunburst, *Toole*	Kootenai *	1922	0			50,000	64,765	1,943			
68	Kevin-Sunburst, *Toole*	Ellis-Madison	1922-1926	23,880	53,089,338	1,557,933	0					
69	Kicking Horse, *Toole,*	Totals						331	77			
70	Kicking Horse, *Toole*	Colorado *	1944	0			300	x	x			
71	Kicking Horse, *Toole*	Ellis *	1944	0			300	x	x			
72	Kremlin, *Hill*	Eagle *	1921	0			640	(F)	(F)			
73	Lake Basin, *Stillwater*	Totals			464,093	1,838		6,256	0			
74	Lake Basin, *Stillwater*	Eagle, Frontier *	1922	0			0x	6,256	Abd			
75	Lake Basin, *Stillwater*	Cloverly	1924	200	464,093	1,838	0					
76	Marias River, *Toole*	Colorado *	1940	0			640x	270	Abd			
77	Melstone, *Musselshell*	Amsden	1948	300	83,927	70,129	0					
78	Musser, *Yellowstone*	Cloverly	1936	80	32,930	1,080	0					
79	101 Ranch-Plevna, *Fallon*	Judith River *	1946	0			1,280	0	0			
80	Pondera, *Pondera, Teton*	Madison	1928	3,000	8,425,055	515,140	0	(F,L)	(F,L)			
81	Pritchard, *Toole*	Colorado *	1915	0			640	0	0			
82	Ragged Point, *Musselshell*	Kibbey	1947	80	198,113	104,314	0					
83	Rattlesnake Butte, *Petroleum*	Kootenai	1946	80	0	0	0					
84	Reagan, *Glacier*	Totals			293,221	225,858						
85	Reagan, *Glacier*	Colorado *	1949	0			160	(F)	(F)			
86	Reagan, *Glacier*	Madison	1941-1942	680	293,221	225,858	1,200	(F,L)	(F,L)			

LINE NUMBER	NUMBER OF WELLS[C]			WELLS PRODUCING[F] DEC. 1949			RESERVOIR PRESSURE LB PER SQ INCH		SECONDARY RECOVERY[H]	CHARACTER OF OIL[A]		PRODUCING FORMATION					DEEPEST ZONE TESTED[T] TO END OF 1949	
	COMPLETED TO END 1949	1949 COMPLETED	1949 ABANDONED	OIL FLOWING	OIL ARTIFICIAL LIFT	GAS	INITIAL	AVG.-/END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[I]	POROSITY PER CENT[J]	DEPTH TO TOP OF PRODUCING ZONE FT[K]	PROD. THICKNESS AVG. FT / NET	STRUCTURE[R]	NAME	DEPTH OF HOLE, FT
1	3	0	0	0	0	0	450	450				S		2,000	39	D	Colorado	2,043
2	2	0	0	0	0	0	400					S		1,240	14	D	Madison	3,569
3	34	1	0	0	1	0				38	1.9	S		1,435	30	D	Devonian	3,115
4	9	0	0	0	2	0										N	Cambrian	5,015
5	1	0	0	0	0	0						S		1,300	15			
6	4	0	0	0	2	0				38	.8	S		1,700	25			
7	3	0	0	0	0	0						S		2,800	20			
8	1	0	0	0	0	0						L		3,005	40			
9	3	0	0	0	1	0				33	.5	S		1,435-2,420	20-30	N	Madison	2,683
10	10	7	0	0	10	0	1,450			32		L S		2,815	9	D	Kibbey	3,617
11	24	0	0	0	12	0				39	1.0	S		2,470	25	N	Madison	2,852
12	2	0	0	0	0	0	380					S		2,100	45	T-N	Madison	2,633
13	346	26	3	0	0	306	274	218	U			Sh S		670	30-40	D	Cambrian	5,852
14	21	3	0	0	0	19										A f	Devonian	4,700
15	30	2	0	0	0	19	263	123				S		655	40+			
16	1	1	0	0	0	0				30	3.5	S		1,377	35			
17	8	0	0	0	0	8	330	165				S		960	20	A f	Eagle	1,395
18	4	0	0	0	4	0				35	1.6	S		1,470	18	N	Madison	1,850
19	2	0	0	0	0	0	240	240				S		640	3	A f	Virgelle	910
20	287	5	0	1	124	0										-	-	
21	19	2	0	0	19	0				51	.3	S		1,775	10	D	Ellis	1,840
22	55	1	0	1	3	0				49		S		875	23	D F	Cambrian	5,705
23	27	1	0	0	24	0				50		S		1,310	17			
24	178	0	0	0	71	0				49	.3	S		1,220	23	D F	Amsden	2,695
25	8	1	0	0	7	0				49		S		1,700	30			
26	279	12	0	0	1	201			U							A	Pre-Cambrian	9,680
27	236	2	0	0	0	134	210	88				S, Sh S		600+	16			
28	80	9	0	0	0	47	375	348				S, Sh S		1,400	10			
29	3	1	0	0	1	0				29	.9	L		6,820	7			
30	2	1	0	0	0	0										A	Madison	9,446
31	1	0	0	0	0	0				45	.1	S		6,445	16			
32	1	1	0	0	0	0	2,350			58		S		7,548	12			
33	4	0	2	0	0	0				43	1.0	S		1,725	12+	N	Devonian	3,695
34	1,417	21	2	4	1,149	138										M C	Madison	3,375
35	1,353	20	2	0	1,093	137	710	410	C, S	37	1.0	S		2,850	23			
36	64	1	0	4	56	1	1,000	980		38	.9	L		3,075	8			
37	3	0	0	0	0	0				22	1.5	L S		1,160	5	D	Cambrian	4,081
38	1	1	0	0	0	0	550					S		1,430	9	A	Charles	2,500
39	29	0	0	0	0	23										M	Madison	2,456
40	26	0	0	0	0	23	125	71				S		780	15			
41	3	0	0	0	0	0				30	1.5	L		1,645	3			
42	16	1	0	0	5	8										D f	Cambrian	8,882
43	9	1	0	0	0	8	1,600	900				S		4,100	40			
44	7	0	0	0	5	0	1,250	500		51	.1	S		5,530	12			
45	62	4	0	3	57	0										D	Three forks	5,388
46	23	0	0	0	21	0			C	43	.1	S		1,445	40			
47	32	1	0	1	31	0	1,300		U, P	29	1.7	S		5,075	110			
48	7	3	0	2	5	0			U	29	1.7	L		5,130	175			
49	11	1	0	4	6	1										D f	Madison	6,957
50	8	1	0	4	4	0	1,400	880		47	.4	S		3,345	40			
51	1	0	0	0	0	1	1,100					S		4,375	30			
52	2	0	0	0	2	0			U	30	1.3	L		6,390	190			
53	4	0	0	0	1	0										D	Cambrian	5,149
54	2	0	0	0	0	0	375	375				S		1,760	18			
55	2	0	0	0	1	0				32	1.0	S		2,600	20			
56	2	0	0	0	2	0				27	2.4	S		3,665	12	D f	Tensleep	3,697
57	1	0	0	0	0	0	200	200				S		1,510	15	N	Kootenai	2,116
58	8	0	1	0	6	0	350			33	.8	S		5,965	7	D	Madison	7,495
59	1	0	0	0	0	0	645	645				S		2,343	10	N	Madison	2,588
60	2	0	0	0	0	0	198	135				S		435	40	D	Madison	2,035
61	93	2	0	0	0	59	140	45				S		735	10	M L	Tensleep	4,195
62	12	0	0	0	0	1	540	180				S		975	85	A f	Colorado	1,637
63	2	0	0	0	0	2	404	230				S		1,940	42	D	Madison	2,923
64	1	0	0	0	0	0	1,000	1,000				D S		3,800	195	D	Madison	5,910
65	1	1	0	0	0	0				40		S		500	9	D f	Morrison	1,012
66	2,498	84	24	1	1,596	198										D	Cambrian	4,916
67	220	5	1	0	0	198	329	112				S		1,100	23			
68	2,278	79	23	1	1,596	0				32	1.2	S L		1,200+	11+			
69	4	0	0	0	0	4										D	Madison	2,375
70	3	0	0	0	0	3	580	156				S		1,475	30			
71	1	0	0	0	0	1						S		1,755	20			
72	3	0	0	0	0	1	200	90				S		1,000	25	A f	Madison	3,765
73	20	0	0	0	2	0										A	Madison	6,002
74	15	0	0	0	0	0	240					S		1,310-3,060				
75	5	0	0	0	2	0				44	.1	S		3,960	14			
76	4	0	0	0	0	0	165	70				S		750	12	M L	Ellis	1,982
77	5	4	0	0	5	0				34	.4	S		4,210	14	N	Cambrian	7,625
78	11	0	0	0	0	0				22	1.6	S		1,000	6	D f	Madison	2,568
79	8	1	0	0	0	0	210	210				S		950	15	A x	Judith River	1,260
80	235	15	0	0	205	0				33	1.8	L		2,000	10	T	Pre-Cambrian	5,234
81	1	0	0	0	0	0	260	240				Sh S		1,775	70	N	Madison	2,840
82	3	0	0	0	3	0	2,190			34		S		4,380	14	D	Cambrian	6,312
83	2	0	0	0	0	0				28	.5	S		2,780	6	A f	Kibbey	4,670
84	22	9	0	3	14	4										D	Devonian	6,258
85	1	1	0	0	0	0	279	279				S		2,330	35			
86	21	8	0	3	14	3	1,300	1,200		37	.7	L		3,740	15			

TABLE I - CONTINUED OIL AND GAS PRODUCTION STATISTICS FOR MONTANA

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION AREA PROVED ACRES	OIL PRODUCTION BARRELS TO END OF 1949	OIL PRODUCTION BARRELS DURING 1949	GAS PRODUCTION AREA PROVED ACRES	GAS PRODUCTION MILLION CU FT.[c] TO END OF 1949	GAS PRODUCTION MILLION CU FT.[c] DURING 1949	GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl TO END OF 1949	CONDENSATE PRODUCTION Thousands of Bbl DURING 1949
87	Sherard (Sand Creek), *Choteau*	Eagle *	1923	0			640	(F)	0			
88	Six-shooter, *Sweetgrass*	Claggett *	1947	0			40	(F)	0			
89	Soap Creek, *Big Horn*	Amsden, Madison	1921	300	154,087	3,328	0					
90	Sumatra, *Rosebud*	Amsden	1949	40	839	839	0					
91	Thorpe, *Toole*	Kootenai, Ellis	1941	100	44,116	1,194	0					
92	Utopia (Lothair), *Liberty*	Totals			2,704	0		3	3			
93	Utopia, *Liberty*	Ellis *	1947	40			640	3	3			
94	Utopia, *Liberty*	Madison *	1943	80			640					
95	Utopia, *Liberty*	Jefferson *	1946	0			640					
96	West Pondera, *Teton*	Colorado *	1939	0			160	(F)	(F)			
97	Whitlash, *Liberty*	Totals			107,592	11,792		14,651	844			
98	Whitlash, *Liberty*	Colorado *	1938	120			11,000					
99	Whitlash, *Liberty*	Kootenai *	1932	120			11,000					
100	Whitlash, *Liberty*	Ellis	1945	40			0					
101	Winifred, *Fergus*	Eagle *	1935	0			1,120					
102	Woman's Pocket, *Golden Valley*	Amsden	1948	40	1,457	1,457	0					
103	TOTAL MONTANA			73,965	158,902,901	9,126,110	380,020	515,381*	41,245		0x	0x

TABLE I - OIL AND GAS PRODUCTION STATISTICS FOR NORTH DAKOTA

1	Cedar Creek [17] *Billings*	Eagle *	1939	0			13,600	2,817	534			

TABLE I - OIL AND GAS PRODUCTION STATISTICS FOR SOUTH DAKOTA

1	Ardmore, *Fall River*	Newcastle *	1944	0			240	0	0			
2	Pierre, *Hughes*	Dakota *	1892x	0			640x	x	8			

TABLE I - OIL AND GAS PRODUCTION STATISTICS FOR UTAH

1	Ashley Creek, *Uintah*	Totals			548,670	533,509		725	184			
2	Ashley Creek, *Uintah*	Morrison *	1925	0			200	545	4x			
3	Ashley Creek, *Uintah*	Weber	1948	670	548,670	533,509	0	F, L. 180	F, L. 180			
4	Bar-X, *Grand*	Morrison *	1948	0			40	(FROM CO_2)	S.I.			
5	Boundary Butte, *San Juan*	Totals			15,693	14,403						
6	Boundary Butte, *San Juan*	Cocomino 1924-	1948	80	15,693	14,403	0					
7	Boundary Butte, *San Juan*	Hermosa * 1929-	1948	0			2,500	F. 0	F. 0			
8	Cisco, *Grand*	Dakota, Morrison *	1924	0			4,000	3,144	F. 1			
9	Clay Basin, *Daggett*	Totals						62,901	6,126 [13]			
10	Clay Basin, *Daggett*	Frontier *	1927	0			1,280	2,869	166		x	x
11	Clay Basin, *Daggett*	Dakota *	1935	0			4,240	60,385	5,960		x	x
12	Farnham, *Carbon*	Cocomino *	1924	0			1,360	1,706	94 (CO_2 GAS)			
13	Garden Creek, *Carbon*	Weber(sqa (Sanbal) *	1948	0			160x	0	S.I. (CO_2 GAS)			
14	Harley Dome, *Grand*	Morrison, Entrada *	1925	0			x	0x	Abd. (HELIUM GAS)			
15	Last Chance, So., *Emery*	Weber(sqa *	1934	0			0x	F	Abd.			
16	Roosevelt, *Uintah*	Green River	1949	40	78,442	78,442	0	L	L			
17	San Juan, *San Juan*	Ismay, Hermosa	1908	160x	16,000x	0x	0					
18	Upper Valley, *Garfield*	Hermosa	1949	40x	11,000 [10]	11,000 [10]	0					
19	Virgin, *Washington*	Weber(sqa	1907	680	183,330	S.I.	0					
20	Woodside, *Emery*	Cocomino *	1924	0			1,000x	0	S.I. (HELIUM GAS)			
21	TOTAL UTAH			1,670	853,115	637,354	13,300	66,782*	6,338		303,212	9,919

TABLE I - OIL AND GAS PRODUCTION STATISTICS FOR WYOMING

1	Adon, *Campbell*	Minnelusa	1949	40	36,824	2,773	0					
2	Alkali Butte, *Fremont*	Totals			10,978	361		47 (F)	0			
3	Alkali Butte, *Fremont*	Muddy	1938	40	10,978	361	0					
4	Alkali Butte, *Fremont*	Lakota*, Morrison *	1931-3	0			120	47 (F)	0			
5	Allen Lake, *Carbon*	Totals						1,815	Abd			
6	Allen Lake, *Carbon*	Muddy *	1918	0			100	x	0			
7	Allen Lake, *Carbon*	Sundance *	1933	0			100	x	0			
8	Allen Lake, East, *Carbon*	Totals			37,724	37,724		4,808	0 (F)			
9	Allen Lake, East, *Carbon*	Sundance *	1937				350	4,808	(F)			
10	Allen Lake, East, *Carbon*	Casper (Tensleep)	1948	60	37,724	37,724	0					
11	Antelope, East, *Fremont*	Wasatch *	1947	0			60	0	0			
12	Ant Hills (So.), *Niobrara*	Fall River	1927	100	19,343	0	0	(F,L)	(F,L)			
13	Ant Hills, (No.), *Niobrara*	Fall River, Lakota	1947-48	120	43,392	3,544	0	(F,L)	(F,L)			
14	Arminto, *Natrona*	Frontier *	1924	0			0x	(F)	Abd			
15	Aspen, *Uinta*	Bear River	1903-38	0x	Non-com.		0					
16	Badger Basin, *Park*	Frontier	1930	1,000	1,724,330	180,013	0	(F,L)	(F,L)			
17	Bailey Dome, *Carbon*	Totals			247,073	14,449		1,096	23 [14]			
18	Bailey Dome, *Carbon*	Nugget	1944	360	199,325	7,327	0	x	x			
19	Bailey Dome, *Carbon*	Tensleep	1946	100	47,748	7,122	0	x	x			
20	Baxter Basin, *Sweetwater*	Totals, Entire Structure			6,355	100		125,118	9,054		x	x
21	Baxter Basin, Middle	Totals						7,644	775 [15]			
22	Baxter Basin, Middle	Frontier *	1938	0			2,700	1,320	238			
23	Baxter Basin, Middle	Dakota *	1938	0			2,700	2,504	98			
24	Baxter Basin, Middle	Lakota *	1946	0			360	1,855	439			
25	Baxter Basin, North	Totals			6,355	100		33,917	2,982 [15]		x	x
26	Baxter Basin, North	Dakota *	1938	0	(C)	(C)	1,300	19,827	463		x	x
27	Baxter Basin, North	Morrison *	1929	0	(C)	(C)	1,300	8,938	128		x	x

LINE NUMBER	NUMBER OF WELLS[c]			WELLS PRODUCING[f] DEC. 1949			RESERVOIR PRESSURE LB. PER SQ. INCH		SECONDARY RECOVERY[g]	CHARACTER OF OIL[h]		PRODUCING FORMATION					DEEPEST ZONE TESTED[n] TO END OF 1949	
	COMPLETED TO END 1949	1949		OIL		GAS	INITIAL	AVG. /END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT.	PROD. THICKNESS AVG. FT. NET	STRUCTURE[k]	NAME	DEPTH OF HOLE, FT.
		COMPLETED	ABANDONED	FLOWING	ARTIFICIAL LIFT													
87	1	0	0	0	0	0	570	570				S S		1,735	25	A F	Colorado	2,983
88	1	0	0	0	0	0	80					S		495	15	D	Madison	4,375
89	7	0	0	1	0	0				18	3.8	S L		1,670+	30	D	Pre-Cambrian	4,470
90	1	1	0	0	1	0				32		S		4,385	15	D	Madison	6,006
91	4	0	0	0	2	0				37	.8	S		1,850	12	M	Madison	2,233
92	6	0	0	0	0	1										D	Cambrian	4,593
93	3	0	0	0	0	1	1,000			34		S		2,345	15			
94	2	0	0	0	3	0	1,130			20	4.3	L		2,500	35			
95	1	0	0	0	0	0	1,440					L		3,570	30			
96	1	0	0	0	0	0						S&S		1,560	5	N	Madison	2,320
97	33	4	0	0	8	24										D	Cambrian	4,068
98	x						230	230				S		1,600	30			
99	x											S		2,000	35			
100	x									37	.9	S		2,300	30			
101	6	0	0	0	0	0	80					S		340	12	A f	Kootenai	3,305
102	1	0	0	0	0	0				21		L S		2,108	11	A	Madison	4,000
103	5,983	204	32	17	3,217	998												

1	29	3	1	0	0	28	375	111	U			S&S		1,060	12	A	Eagle	1,727

1	6	0	0	0	0	0	35					S		885	5+		Minnelusa	3,175
2	5	0	0	0	0	5	130±	±				S		1,285	5	M	Lakota	1,450

1	29	25	0	27	0	1										D	Weber	4,327
2	2	0	0	0	0	1	580	10±				S		1,430	8			
3	27	25	0	27	0	0	1,982			32	.8	S		4,150	75			
4	1	0	0	0	0	0	1,300	1,300				S		3,533		D	Navajo/Pre-Cambrian	4,497
5	6	2	0	0	3	0										A	Ignacio	6,090
6	3	2	0	0	3	0				43		S		1,575	10			
7	3	0	0	0	0	0	1,140	1,140				L		4,450				
8	10	0	0	0	0	1	400	150±				S		2,000	30	D	Pre-Cambrian	4,744
9	11	0	0	0	0	10			U							D	Weber	9,355
10	2	0	0	0	0	2	2,180	1,778				S		5,450	30			
11	9	0	0	0	0	8	2,230	1,107				S		5,700	40			
12	3	0	0	0	0	2	900	890±				S		3,100	20	A f	Hermosa	5,722
13	1	0	0	0	0	0			U			S		10,890	50	A f	Cocoanino	12,146
14	2	0	0	0	0	0	157					S		530,860	15	D	Wingate	1,675
15	1	0	0	0	0	0	480					L S		2,530	50	D	Cambrian x	8,518
16	1	1	0	1	0	0	4,350	4,350				L S		9,360	30	M F	Green River	9,391
17	16	0	0	0	5±	0				39	.2	L S		200*		S	Pre-Cambrian	3,633
18	1	1	0	0	0	0			U	17	.2	L S		8,777	14	A	Wedwil	8,857
19	53	0	0	0	0	0				31	.8	L		550	5	M	Dupai	2,195
20	1[(o)]	0	0	0	0	0	410					S		3,120	65	D	Cocoanino	3,375
21	136	29	0	28	8	14												

1	1	0	0	0	0	0	3,575		U	31	1.2	S		9,000	13	A	Madison	9,945
2	3	0	0	0	0	0			U							A F	Tensleep	7,430
3	1	0	0	0	0	0				34	- .1	S		3,960	10			
4	2	0	0	0	0	0	1,775					S		4,380+	10+			
5	5	0	0	0	0	0										D	Casper	4,362
6	2	0	0	0	0	0	850	25				S		1,380	40			
7	3	0	0	0	0	0						S		2,090	70			
8	4	0	2	0	1	0										D	Casper	3,964
9	3	0	2	0	0	0	1,000	25				S		2,080	50			
10	1	0	0	0	1	0	1,800			22	.9	S		3,927	36			
11	1	0	0	0	0	0	900	900	U			S		2,157	20	D	Steele	6,613
12	1	0	0	0	0	0	1,100			34	.1	S		3,945	12	D	Pahasapa	6,825
13	3	0	0	0	0	0				34	.1	S		4,860	15	T x	Lakota	5,115
14	1	0	0	0	0	0						S		1,785	10	A	Mowry	3,539
15	3	0	0	0	0	0				24	.3	S		860	15	M U	Bear River x	5,092
16	10	0	0	8	0	0	3,000			48	-.1	S		8,220	130	D	Madison	11,827
17	4	0	0	0	4	0			U							D	Tensleep	7,320
18	3	0	0	0	3	0	2,300			34	.3	S		5,190	30			
19	1	0	0	0	1	0				34		S		6,965	10			
20	52	2	0	0	0	36												
21	4	0	0	0	0	4										D F	Weber	5,517
22	4	0	0	0	0	1	1,000	480				S		1,900	25			
23	2	0	0	0	0	2	1,025	585				S		2,500	25			
24	1	0	0	0	0	1	1,130	790				S		2,700	40			
25	14	2	0	0	0	10										D F	Weber	6,425
26	3	0	0	0	0	3	1,335	738				S		3,000	15			
27	5	0	0	0	0	1	1,450	930				S		3,500	15			

TABLE 1 – CONTINUED OIL AND GAS PRODUCTION STATISTICS FOR WYOMING

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION (Thousands of Bbl)	
				AREA PROVED ACRES	BARRELS TO END OF 1949	BARRELS DURING 1949	AREA PROVED ACRES	MILLION CU FT TO END OF 1949	MILLION CU FT DURING 1949		TO END OF 1949	DURING 1949
28	Hunter Basin, North	Nugget *	1945	120	6,355	100	2,000	5,427	2,436		x	x
29	Hunter Basin, North	Totals						63,553	5,205	[3]		
30	Hunter Basin, South	Frontier *	1924	0			7,000	27,447	2,544			
31	Hunter Basin, South	Dakota *	1922	0			7,000	56,760	2,753			
32	Hunter Basin, South	Totals			106,975	106,975		21,750	6,178		x	x
33	Beaver Creek, Fremont	Frontier *	1947	0	(C)	(C)	4,730	x	x		x	x
34	Beaver Creek, Fremont	Muddy *	1947	0	(C)	(C)	4,730	x	x		x	x
35	Beaver Creek, Fremont	Cloverly *	1938	0	(C)	(C)	4,730	x	x		x	x
36	Beaver Creek, Fremont	Tensleep	1949	1,730	106,975	106,975	0	(L)	(L)			
37	Hell Springs, Carbon	Totals						390	50			
38	Hell Springs, Carbon	Dakota *	1924	0			60	x	50			
39	Hell Springs, Carbon	Sundance *	1944	0			60	x	Abd			
40	Big Hollow, Albany	Muddy	1938	120	17,682	900	0					
41	Big Medicine Bow, Carbon	Totals			4,919,434	143,859		x	x			
42	Big Medicine Bow, Carbon	Sundance (Lot F 2nd)	1935	705	4,848,981	79,785	0	x	(F) 168			
43	Big Medicine Bow, Carbon	Casper (Tensleep)	1948	80	70,453	64,074	0					
44	Big Muddy, Converse	Totals			31,904,241	682,839		(F,L)	(F,L)			
45	Big Muddy, Converse	Niobrara, Shannon	1916	2,640	x	x	0					
46	Big Muddy, Converse	Frontier	1916	2,640	x	x	0					
47	Big Muddy, Converse	Dakota	1922	840	x	x	0					
48	Big Muddy, Converse	Lakota	1922	190	x	x	0					
49	Big Piney, Sublette	Wasatch *	1938	0			1,760	(F,L)	(F,L)			
50	Big Polecat, Park	Frontier *	1916	0			800	3,956	1,012			
51	Big Sand Draw, Fremont	Totals			6,975,303	2,214,832		102,529	4,706			
52	Big Sand Draw, Fremont	Frontier *	1938	0			1,960					
53	Big Sand Draw, Fremont	Cloverly *	1937	0			1,960	100,893	3,060			
54	Big Sand Draw, Fremont	Morrison *	1939	0			1,960					
55	Big Sand Draw, Fremont	Phosphoria *	1948	0	(C)	(C)	700	1,646	1,646		x	x
56	Big Sand Draw, Fremont	Tensleep	1944	700	6,975,303	2,214,832	0					
57	Billy Creek, Johnson	Frontier *	1923	0			120	3,239	(S) 0			
58	Bison Basin, Fremont	Frontier	1929	160	0	S.I.	80	(F)	(F)			
59	Black Mountain, Hot Springs, Washakie	Totals			507,441	48,569						
60	Black Mountain, Hot Springs, Washakie	Embar	1926	615	547,662	44,244	0					
61	Black Mountain, Hot Springs, Washakie	Tensleep	1924	615			0					
62	Black Mountain, Hot Springs, Washakie	Madison	1946	165	49,779	4,325	0					
63	Bolton Creek, Natrona	Totals			43,335	0	0					
64	Bolton Creek, Natrona	Sundance	1920	60	10,000x	0	0					
65	Bolton Creek, Natrona	Phosphoria	1920	80	33,335x	0	0					
66	Boone Draw, Natrona	Steele *	1923	0			300	1,368	11			
67	Borie, Laramie	Muddy	1949	200	26,623	26,623	0					
68	Bremmng Basin, Converse	White River	1912b	80	7,052	Abd	0					
69	Bridge Creek, Niobrara	Fall River	1948	40	1,909	0	0					
70	Bunker Hill, Carbon	Steele (Shannon) *	1917	0			550	2,769	275			
71	Byron, Big Horn	Totals			21,345,655	1,440,664						
72	Byron, Big Horn	Frontier *	1918	0			600	4,946d	140			
73	Byron, Big Horn	Sundance	1929	20	x	x	0					
74	Byron, Big Horn	Embar	1930	1,840	x	x	0					
75	Byron, Big Horn	Tensleep	1930	1,890	x	x	0					
76	Canyon Creek, Sweetwater	Wasatch *	1941	0			60	(F)	(F)			
77	Casper Creek, So., Natrona	Tensleep	1925	0a	11,662	Abd	0	(F)	0			
78	Casper Creek, So., Natrona	Totals			4,459,104	165,245						
79	Casper Creek, So., Natrona	Sundance *	1939	0	x	x	940	9,531	(F)			
80	Casper Creek, So., Natrona	Tensleep	1922	600	x	x	0					
81	Castle Creek, Natrona	Frontier	1948	80	9,461	6,753	0					
82	Church Buttes, Sweetwater, Uinta	Dakota *	1946	0	(C)	(C)	2,560	5,133	4,304	[3]	x	x
83	Circle Ridge, Fremont	Totals			2,733,312	271,571						
84	Circle Ridge, Fremont	Phosphoria	1923	150	2,708,687	271,571	0					
85	Circle Ridge, Fremont	Tensleep	1923	350			0					
86	Circle Ridge, Fremont	Madison	1946	80	24,625	0	0					
87	Cole Creek, Natrona, Converse	Totals			4,445,065	502,077						
88	Cole Creek, Natrona, Converse	Steele (Shannon)	1941	1,650	3,057,378	312,426	0	(F)	(F)			
89	Cole Creek, Natrona, Converse	Dakota-Lakota	1938	630	1,387,687	189,651	0	(F)	(F)			
90	Cole Creek, So., Converse	Lakota	1948	330	185,681	159,868	0	(F)	(F)			
91	Casper Cove, Carbon	Lakota group	1944	100	175,302	38,745	0					
92	Corley, Hot Springs	Embar	1946	0a	38,000	Abd	0					
93	Cow Gulch, Niobrara	Minnelusa	1947	60	4,161	2,821	0					
94	Crooks Gap, Fremont	Totals			3,155,898	591,863		240	1434f			
95	Crooks Gap, Fremont	Muddy	1947	270	373,728	115,353	0	45	6			
96	Crooks Gap, Fremont	Lakota	1944	330	2,782,170	476,510	0	195	137			
97	Crystal Creek, Big Horn	Tensleep	1919	40	Non-com.	0	0					
98	Dallas, Fremont	Totals			3,942,761	173,020						
99	Dallas, Fremont	Phosphoria	1884	160	x	x	0					
100	Dallas, Fremont	Tensleep	1927	160	x	x	0					
101	Dunker, So., Park	Frontier *	1948	0			300	0	S.I.			
102	Derby, Fremont	Totals			642,839	10,473						
103	Derby, Fremont	Phosphoria	1921	120	x	x	0					
104	Derby, Fremont	Tensleep	1921	120	x	x	0					
105	Dewey, Grafton	Minnelusa	1936	5a	9,248	S.I.	0					
106	Douglas, So., Converse	White River *	1946	0			120	0	0			
107	Dry Piney, Sublette	Hilliard *	1918	0a	Non-com.	0	0a	(F)	(F)			
108	Dubois, Fremont	Phosphoria	1946	80	15,868	4,456	0					

LINE NUMBER	NUMBER OF WELLS[4]			WELLS PRODUCING[7] DEC. 1949			RESERVOIR PRESSURE LB PER SQ INCH		SECONDARY RECOVERY[8]	CHARACTER OF OIL[9]		PRODUCING FORMATION					DEEPEST ZONE TESTED[10] TO END OF 1949	
	COMPLETED TO END 1949	1949		OIL		GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[1]	POROSITY PER CENT[2]	DEPTH TO TOP OF PRODUCING ZONE FT.[6]	PROD. THICKNESS AVG. FT./ NET	STRUCTURE[11]	NAME	DEPTH OF HOLE, FT
		COMPLETED	ABANDONED	FLOWING	ARTIFICIAL LIFT													
58	6	2	0	0	0	6	1,650	1,603		36	.2	S		4,000	30			
59	31	0	0	0	0	22			U							D F	Morgan	7,172
60	16	0	0	0	0	13	770	453				S		2,345	25			
61	15	0	0	0	0	9	800	540				S		3,080	25			
62	10	1	0	1	0	9			U							U	Amsden	10,903
63	1[60]	0	0	0	0	1	2,975			56	.1	S		7,455	40			
64	1[61]	0	0	0	0	1	3,050			56	.1	S		8,515	15			
65	7	0	0	0	0	7	3,220			56	.1	S		8,400	45			
66	1	1	0	1	0	0	4,749	4,375		45	.6	S		10,440	250			
67	3	0	0	0	0	1										D F	Deadwood	4,466
68	2	0	0	0	0	1	860	800				S		1,850	40			
69	1	0	0	0	0	0	1,100	900				S		2,270	60			
70	5	0	0	0	1	0				19	.1	S		925	10	D	Casper	2,753
71	19	1	0	2	3	0										D	Pre-Cambrian	7,842
72	11	0	0	0	3	0	2,510			63	.1	S		5,250	50			
73	2	1	0	2	0	0	2,804		U	61	.1	S		6,730	100			
74	323	5	6	0	153	0										D f	Madison	6,597
75	91	0	0	0	13	0				34	.1	S		1,000	32			
76	177	0	4	0	92	0				34	.1	S		3,100	56			
77	49[113]	5	2	0	42	0				36	.1	S		4,300	10			
78	6	0	0	0	6	0				32	.5	S		4,335	30			
79	8	0	0	0	0	0	750±	750±				S		1,100	30	M T	Cretaceous	3,846
80	4	0	0	0	0	3	950					S		2,520	40	D f	Mowry	3,343
81	26	2	0	10	0	16			U							A	Madison	8,169
82	12	0	0	0	0	12	1,060	431				S		3,180	60			
83	2[114]	0	0	0	0	2	1,800	630				S		4,340	30			
84	2	0	0	0	0	2	1,680	593				S		4,640	15			
85	1	0	0	[62]1	0	0	3,300	2,571		62	.3	L		6,850	85			
86	9	2	0	9	0	0	3,325	3,180		35	1.3	S		7,425	200			
87	9	0	0	0	0	0	1,150		U			S		3,140	12	D	Bluhorn	7,775
88	10	0	0	0	0	0	42	20	U	17	.4	S		975	30	D f	Tensleep	4,923
89	9	1	0	0	5	0			U							A f	Cambrian	5,032
90	2	0	0	0	1	0				24	2.7	L		2,935	40			
91	6	1	0	0	3	0				22	2.8	S		3,230	50			
92	1	0	0	0	1	0				20	3.4	L		3,865	9			
93	13	0	0	0	0	0										U	Tensleep	2,530
94	6	0	0	0	0	0				22	2.3	S		1,080	15			
95	2	0	0	0	0	0				32	2.3	L		2,110	20			
96	5	0	0	0	0	2	760					S		1,760-2,185	20	A	Carlile x	7,518
97	1	1	0	1	0	0				38				8,528	20	D	Pre-Cambrian	11,774
98	56	0	0	0	0	0				34	.4	S		360	10	M U	Sundance	1,405
99	1	0	0	0	0	0				38		S		2,570	4		Morrison	2,922
100	4	0	0	0	0	4	530	350				S		1,400	80	D f	Madison	9,392
101	55	1	0	0	50	2										D f	Madison	6,065
102	3	0	0	0	0	2	650					S		2,250	30			
103	1	0	0	0	0	0				31	.7	S		4,210	20			
104	3	0	0	0	3	0	2,056			18	2.9	L		5,230	30			
105	48[110]	1	0	0	47	0				24	1.8	S		5,345	50			
106	1	0	0	0	0	0	1,250	1,250	U			S		2,690	20	D	Morrison	13,321
107	5	0	0	0	0	0				22	2.8	S		3,200	10	D	Pre-Cambrian	4,638
108	42	0	0	0	27	1										D	Cambrian	3,342
109	12	0	0	0	0	1	440	20				S		1,475	60			
110	30	0	0	0	27	0				16	4.5	S		2,300	50			
111	3	1	0	0	3	0			U	22		S		2,260	9	D z	Morrison	3,303
112	4	0	0	0	0	4	5,400	5,300	U	47	[65].1	S		12,550	50	A	Nugget	14,646
113	26	1	0	0	25	0										D	Madison	2,964
114	16	0	0	0	5	0				23	2.8	L		430	35			
115	119	1	0	0	19	0				24	2.8	S		730	110			
116	1	0	0	0	1	0				24	2.7	L		1,630	30			
117	39	0	0	0	34	0			U							D	Chugwater	8,707
118	31	0	0	0	26	0	1,650	920	W	36	.1	S		4,500	17			
119	8	0	0	0	8	0	3,550			36	.1	S		7,950	30			
120	3	2	0	2	1	0	3,700		U	35	-.1	S		8,395	32	D	Tensleep	10,207
121	2	0	0	0	2	0				33	.3	S		6,830	40	D	Jelo	5,373
122	3	0	0	0	0	0				24	2.8	L		4,105	34	D	Madison	5,075
123	3	2	0	0	3	0				27	1.6	S		1,455	10	A	Ten-Mile ?	2,907
124	8	0	0	8	1	0			U							A f	Phosphoria	8,733
125	3[113]	0	0	2	0	0				39	.2	S		4,900	60			
126	8	0	0	6	1	0				39	.2	S		5,100	35			
127	2	0	0	0	0	0				39	3.7	S		980	20	A f	Madison	1,805
128	45	4	0	0	33	0										D	Madison	1,957
129	32	0	0	0	21	0				19	2.9	L		955	25			
130	13	4	0	0	12	0				20	3.0	S		1,150	80			
131	1	0	0	0	0	0	1,100	1,100	U			S		2,810	90	D f	Madison	6,306
132	16	0	0	0	10	0										D	Madison	3,189
133	12	0	0	0	6	0				21	2.7	L		980	15			
134	4	0	0	0	4	0				24	2.7	S		1,190	25			
135	1	0	0	0	0	0				32	1.2	S		2,300	4	M f	Minnelusa	2,466
136	3	0	0	0	0	0	175	175				S		600	13	M U	Pierre	3,390
137	2	0	0	0	0	0	2,100	2,100		42	.1	S		940 ?	30	A	Bear River	8,394
138	1	0	0	0	0	0			U	20	2.5	L		2,060	60	D z	Tensleep	2,720

TABLE I – CONTINUED OIL AND GAS PRODUCTION STATISTICS FOR WYOMING

LINE NUMBER	FIELD (County)[A]	PRODUCING FORMATION NAME AND AGE[A]	YEAR OF DISCOVERY	OIL PRODUCTION AREA PROVED ACRES	OIL PRODUCTION BARRELS TO END OF 1949	OIL PRODUCTION BARRELS DURING 1949	GAS PRODUCTION AREA PROVED ACRES	GAS PRODUCTION MILLION CU. FT. TO END OF 1949	GAS PRODUCTION MILLION CU. FT. DURING 1949	GAS/OIL RATIO[J] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl TO END OF 1949	CONDENSATE PRODUCTION Thousands of Bbl DURING 1949
109	Hatton Creek, *Carbon*	Totals			997,447	11,432		2,137	116			
110	Hatton Creek, *Carbon*	Steele (Shannon) *	1932	0			240	2,137	116			
111	Hatton Creek, *Carbon*	Muddy	1927	160	997,447	11,432	0					
112	Elk Basin [1121] *Park*	Totals			37,842,450	5,322,697						
113	Elk Basin, *Park*	Frontier	1915	730	11,326,330	90,038	0					
114	Elk Basin, *Park*	Cloverly *	1922	0			750	39,130	97			
115	Elk Basin, *Park*	Tensleep	1942	4,730	23,893,033	3,680,893	0	(F,L)	1,14956			
116	Elk Basin, *Park*	Madison	1946	3,470	2,623,287	1,550,666						
117	Elk Basin, South, *Park*	Totals			1,574,498	300,259		4,288	1,683			
118	Elk Basin, South, *Park*	Cloverly*, Morrison *	1946	0	(C)	(C)	730	4,288	1,683		x	x
119	Elk Basin, South, *Park*	Tensleep	1945	440	1,574,498	300,259	0					
120	Enos Creek, *Hot Springs*	Totals			30,272	25,145						
121	Enos Creek, *Hot Springs*	Frontier	1923	0			40	(F)	(F)			
122	Enos Creek, *Hot Springs*	Tensleep	1948	50	30,272	25,145	0					
123	Ferris, *Carbon*	Totals			291,690	Abd		x	x			
124	Ferris, *Carbon*	Mowry, Muddy	1919	0x	291,690	0						
125	Ferris, *Carbon*	Dakota *	1920	90			160	-				
126	Ferris, *Carbon*	Sundance *	1922	20			300					
127	Fiddler Creek, *Weston*	Newcastle	1948	1,700	1,270,359	1,258,379	0	(F,L)	(F,L)			
128	Fourtear, *Park*	Totals			11,502	S.I.						
129	Fourtear, *Park*	Tensleep	1928	400	11,502	0	0					
130	Fourtear, *Park*	Amsden-Madison	1948	80	0	0	0					
131	Frannie [1131] *Park*	Totals			16,010,496	1,304,863		(L)	(L)			
132	Frannie, *Park*	Tensleep	1928	1,250	x	x	0					
133	Frannie, *Park*	Madison	1929	100	x	x	0					
134	Frisby, So., *Washakie*	Embar	1949	90	3,523	3,523	0					
135	Garland, *Big Horn, Park*	Totals			15,740,139	1,196,761		50,401	2,197			
136	Garland, *Big Horn, Park*	Frontier *	1906	640x	550,000x	0	640	x	x			
137	Garland, *Big Horn, Park*	Cloverly *	1915	0			160	x	x			
138	Garland, *Big Horn, Park*	Morrison *	1944	0			160	x	x			
139	Garland, *Big Horn, Park*	Embar-Tensleep	1927-1928	1,480	x	x	1,480	x	x			
140	Garland, *Big Horn, Park*	Madison	1930	960	x	x	0	x	x			
141	Gebo, *Hot Springs*	Embar	1943	795	2,739,214	192,966	0	(F,L)	(F,L)			
142	Glenrock, *Converse*	Muddy	1949	120		0	0					
143	Golden Eagle, *Hot Springs*	Totals			145,183	103,877		2,671	100			
144	Golden Eagle, *Hot Springs*	Mesaverde *	1921	0			160x	2,546	Abd			
145	Golden Eagle, *Hot Springs*	Muddy *	1944	0	51,671	10,365	1,480	125	100			
146	Golden Eagle, *Hot Springs*	Dakota	1945	480	(partly	condensate)	0					
147	Golden Eagle, *Hot Springs*	Tensleep	1949	480	93,512	93,512	0		61 (L)			
148	Gooseberry, *Park*	Embar-Tensleep	1937	195	82,687	44,384	0					
149	G. P. "Draw" *Carbon*	Niobrara (G.P. wl)	1920	100	101,471	0	0					
150	Grass Creek, *Hot Springs*	Totals			39,758,068	962,094		3,347	14			
151	Grass Creek, *Hot Springs*	Frontier	1914	1,440	30,295,136	452,590	0	3,347	(F) 14			
152	Grass Creek, *Hot Springs*	Morrison	1921	40			0					
153	Grass Creek, *Hot Springs*	Chugwater	1926	80	8,462,732	509,494	0					
154	Grass Creek, *Hot Springs*	Embar	1922	1,320			0					
155	Grass Creek, *Hot Springs*	Tensleep	1922	1,320			0					
156	Greybull, *Big Horn*	Greybull (Dakota)	1907	300	291,606	3,357	0	299	Abd			
157	Half Moon, *Park*	Totals			296,147	69,412						
158	Half Moon, *Park*	Embar	1944	200	x	x	0					
159	Half Moon, *Park*	Tensleep	1945	200	x	x	0					
160	Hamilton Dome, *Hot Springs*	Totals			16,252,106	1,491,081		(L) 100	(F) 1			
161	Hamilton Dome, *Hot Springs*	Chugwater	1918	40	x	x	0					
162	Hamilton Dome, *Hot Springs*	Embar	1919	1,170	x	x	0					
163	Hamilton Dome, *Hot Springs*	Tensleep	1929	1,170	x	x	0					
164	Hamilton Dome, *Hot Springs*	Madison	1948	400	x	x	0					
165	Hatfield, *Carbon*	Totals			462,709	262,132		1,209	190			
166	Hatfield, *Carbon*	Dakota *	1923	0			320	1,104	94			
167	Hatfield, *Carbon*	Nugget	1949	80	4,162	4,162	80	96	96			
168	Hatfield, *Carbon*	Tensleep	1947	400	458,547	257,970	0					
169	Hay Creek, *Campbell*	Fort Union *	1934	0			80	(F)	(F)			
170	Hay Creek, *Weston*	Newcastle	1949	80	2,476	2,476	0					
171	Heart Mountain, *Park*	Frontier *	1948	0			240	0	0			
172	Derrick Dome, *Albany*	Casper (Tensleep)	1947	70	176,425	39,511	0					
173	Hiawatha, East [1131] *Sweetwater*	Totals			0	0		17,882	937 [11]			
174	Hiawatha, East, *Sweetwater*	Wasatch *	1928	0	(C)	(C)	2,000	17,950	964		x	x
175	Hiawatha, East, *Sweetwater*	Fort Union *	1949	0			640	2	2		0	0
176	Hidden Dome, *Washakie*	Totals			513,626	6,364						
177	Hidden Dome, *Washakie*	Frontier	1918-1932	150	392,348	6,087	640x	22,148	(F)			
178	Hidden Dome, *Washakie*	Tensleep	1947	160	121,308	277	0					
179	Horse Valley, *Carbon*	Mowry *	1930	0			40	-1	0			
180	Horse Creek, *Laramie*	Totals			1,032,092	668,544						
181	Horse Creek, *Laramie*	Muddy	1943	2,340	996,488	668,544	0	(F)	(F)			
182	Horse Creek, *Laramie*	Dakota	1942	275	35,594	0	0					
183	Iron Creek, *Natrona*	Frontier, Dakota	1917	80	71,385	4,974	0x	312	0			
184	Kirby Creek, *Hot Springs*	Totals			305,564	29,014						
185	Kirby Creek, *Hot Springs*	Frontier	1918	80	83,696	937	0					
186	Kirby Creek, *Hot Springs*	Embar	1944	240	121,868	27,077	0					
187	Kuemmerle, *Weston*	Fall River	1948	10	3,269	1,816	0					
188	La Barge, *Lincoln, Sublette*	Wasatch	1924	950	11,626,192	417,551	x	(F)	106 (F)			
189	La Barge, So., *Sublette*	Hilliard x	1928	760	247,057	34,133	80x	(F)	(F)			
190	Lake Creek, *Hot Springs*	(Two separate areas)	Totals		30,552	16,834	0					
191	Lake Creek, *Hot Springs*	Embar	1925	80	13,718	S.I.	0					
192	Lake Creek, *Hot Springs*	Tensleep	1949	80	16,834	16,834	0					
193	Lamb, *Big Horn*	Totals			84,385	17,778		1,819	0			

LINE NUMBER	NUMBER OF WELLS[a]			WELLS PRODUCING[b] DEC. 1949			RESERVOIR PRESSURE LB. PER SQ. INCH		SECONDARY RECOVERY[c]	CHARACTER OF OIL[d]		PRODUCING FORMATION					DEEPEST ZONE TESTED[e] TO END OF 1949	
	COMPLETED TO END 1949	1949		OIL		GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[f]	POROSITY PER CENT[g]	DEPTH TO TOP OF PRODUCING ZONE FT.[h]	PROD. THICKNESS AVG. FT. NET	STRUCTURE[i]	NAME	DEPTH OF HOLE, FT.
		COMPLETED	ABANDONED	FLOWING	ARTIFICIAL LIFT													
109	8	0	0	0	2	5						Sds		1,600	30	D	Sundance	5,466
110	5	0	0	0	0	5	900					S		4,840	30			
111	3	0	0	0	2	0				33	.3							
112	254	8	1	74	117	5										D f	Threeforks	6,285
113	131	0	1	0	86	0			C	45	.1	S		1,570	40			
114	7	0	0	0	0	5	880					S		2,530	30			
115	66	3	0	59	26	0	2,082		U P	30	2.0	S		4,995	130			
116	20	5	0	15	5	0	2,123		U	29	1.9	L		5,200	150			
117	14	1	0	0	11	2			U							D f	Tensleep	7,169
118	3	1	0	0	0	2	2,173 - 1,935					S		5,770	60-40			
119	11	0	0	0	11	0	2,495			28	1.8	S		7,000	50			
120	3	1	0	0	1	1			U							A	Madison	7,139
121	1	0	0	0	0	1	850					S		2,835	15			
122	2	1	0	0	1	0	2,300 v			28	.9	S		6,420	35			
123	19	0	0	0	0	2										D (2)	Tensleep	5,957
124	x	0	0	0	0	0						S	1,210	1,420				
125	14	0	0	0	0	0	715			36	.2	S		1,540[k]	25			
126	5	0	0	0	0	2	1,135			35		S		2,415[k]	20			
127	79	76	0	10	68	0				33-42		S		4,500[k]	10	M T	Spearfish	5,710
128	4	0	0	0	0	0			U							A	Madison	3,941
129	3	0	0	0	0	0				14	3.9	S		3,470	70			
130	1	0	0	0	0	0				15		S L		3,400	85			
131	75	9	0	0	69	0										D f	Madison	4,689
132	73	9	0	0	68	0				26	2.4	S		3,240[k]	50			
133	2	0	0	0	1	0				18	3.2	L		3,040	50			
134	1	1	0	0	1	0			U	32	1.8	L		10,580	80	D	Ember	10,665
135	125	4	0	0	76	13			U							D f	Threeforks	4,424
136	21	0	0	0	0	8	430			41	-.1	S		600	30			
137	32	0	0	0	0	2	720			50	-.1	S		1,750	30			
138	3	0	0	0	0	1	740					S		2,105	35			
139	65	3	0	0	55	1	1,060			24	2.8	L S		3,600	50			
140	24	1	0	0	21	1	1,500			37	3.1	L		3,990	50			
141	30	2	0	0	30	0	2,014		U	29	2.0	L		4,790	70	D	Guiletin	6,608
142	1	1	0	0	0	0				40		S		7,302	23	D f	Thermopolis	7,259
143	5	1	0	1	0	1			U							D	Tensleep	9,582
144	2	0	0	0	0	0	1,200					S		2,680	30			
145	1	0	0	0	0	1	3,007			60	-.1	S		6,720	16			
146	3	0	0	0	0	0	2,893			55	-.1	S		7,165	30			
147	1	1	0	1	0	0				42	.9	S		9,350	125			
148	4	2	0	0	4	0	1,960		U	24	2.2	L S		5,720	35-50	D	Madison	6,965
149	3	0	0	0	0	0				37	2.0	S		2,865	30	N	Frontier	5,465
150	328	3	1	0	226	1										D	Amsden	4,689
151	296	0	0	0	198	1			C	45	.1	S		870	80			
152	1	0	0	0	1	0				16		S		1,887	15			
153	2	1	0	0	2	0				25	2.3	S		3,195	20			
154	19 [1 inj.]	1	1	0	16	0	1,445			25	2.5	L		3,920	30			
155	10	1	0	0	9	0				23	2.7	S		4,130	50			
156	82	0	0	0	9	0				48	.1	S		1,060	20	D f	Cambrian	5,228
157	6	0	1	0	5	0										A f	Madison	4,365
158	2	0	0	0	2	0				15	4.0	L		3,365	25			
159	4	0	1	0	3	0				15	4.0	S		3,590	25			
160	86	7	3	0	77	0										D f	Madison	4,259
161	4	0	0	0	4	0				17	3.3	S		2,280	10			
162	16	0	1	0	14	0				15-21	3.0	L		2,670	25			
163	65	7	2	0	58	0				23	3.0	S		2,840	105			
164	1	0	0	0	1	0				15	3.7	L		3,380	120			
165	12	4	0	6	3	1										D f	Deadwood	6,544
166	3	0	0	0	0	1	1,780					S		3,850	35			
167	1	1	0	1	0	0				32	.7	S		4,320	20			
168	8	3	0	5	3	0				44	1.2	S		5,870	30			
169	2	0	0	0	0	1						S		395	20	T	Fort Union	415
170	1	1	0	0	1	0				40		S		6,196	6		Fall River	6,446
171	2	0	0	0	0	0	1,175					S		2,230	60	A f	Thermopolis	4,018
172	5	0	0	0	5	0				21	3.2	S		3,640	40	D	Fountain	4,230
173	8	1	0	0	0	7										D	Mesaverde	7,577
174	7	0	0	0	0	6	1,100	530-900				S		2,240	30			
175	1	1	0	0	0	x	1,220	1,220				S		4,100	40			
176	36	0	3	0	14	1										A	Madison	5,515
177	31	0	0	0	9	1	725			43	.2	S		1,170	35			
178	5	0	0	0	5	0	1,783			19	3.5	S		4,435	50			
179	1	0	0	0	0	0	260					36S		750	50	A	Tensleep	2,540
180	29	12	0	0	25	0			U							A	Casper	7,457
181	37	12	0	0	25	0	2,170	1,425		35	.2	S		5,300	25			
182	2	0	0	0	0	0				30	.1	S		5,450	10			
183	9	0	0	0	5	1	300			28	.2	S		740	25	D	Tensleep	3,437
184	20	0	0	0	19	0										A	Madison	4,427
185	9	0	0	0	8	0				40	.1	S		390	10			
186	11	0	0	0	11	0				23	3.4	L		3,350	30			
187	1	0	0	0	1	0				34	.1	S		5,370	30	T	Morrison	5,530
188	166	1	3	0	151	3	340		U C	28[j]	.1	S		800	60	A F	Hilliard	4,886
189	17	0	0	7	9	1	800		U	46	.1	S		1,980	20	M Up	Aspen	8,005
190	2	1	0	0	1	0										A		
191	1	0	0	0	0	0				22	3.2	L		3,705	18		Madison	4,455
192	1	1	0	0	1	0	1,450		U	31	2.3	S		3,590	80		Tensleep	3,800
193	11	0	0	0	1	0										D	Tensleep	3,668

TABLE I – CONTINUED OIL AND GAS PRODUCTION STATISTICS FOR WYOMING

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl	
				AREA PROVED ACRES	BARRELS TO END OF 1949	BARRELS DURING 1949	AREA PROVED ACRES	MILLION CU FT[c] TO END OF 1949	MILLION CU FT[c] DURING 1949		TO END OF 1949	DURING 1949
194	Lamb, *Big Horn*	Frontier, Muddy	1913	0			0x	1,819	Abd			
195	Lamb, *Big Horn*	Embar, Tensleep	1945	40	84,385	17,778	0					
196	Lance Creek, *Niobrara*	Totals			82,771,232	2,789,527		x	2,844			
197	Lance Creek, *Niobrara*	Dakota (Fall River)	1918	4,745	3,136,000x	32,500x	80					
198	Lance Creek, *Niobrara*	Sundance (Upper & Lower)	1930	455	33,700,000x	1,136,000x						
			1935	2,695								
199	Lance Creek, *Niobrara*	Nanneluse (Converse,Leo)	1936	285	45,935,000x	1,621,000x						
			1937	4,745								
200	Lance Creek, East, *Niobrara*	Dakota (Fall River)	1919-37	670	790,967	82,512	40	(F,L)	(F,L)			
201	Lander (Hudson), *Fremont*	Totals			3,198,549	148,619						
202	Lander (Hudson), *Fremont*	Phosphoria	1949	320	x	x	0					
203	Lander (Hudson), *Fremont*	Tensleep	1926	190	x	x	0					
204	Lightning Creek, *Niobrara*	Sundance	1949	100	16,039	16,039	0	(L)	(L)			
205	Little Buck Creek, *Niobrara*	Totals			1,742,225	564,589		(F,L)	(F,L)			
206	Little Buck Creek, *Niobrara*	Dakota (Fall River)	1944	410	1,696,215	518,579	0					
207	Little Buck Creek, *Niobrara*	Nanneluse (Converse,Leo)	1948	80	46,010	46,010	0					
			1949									
208	Little Buffalo Basin, *Hot Springs, Park*	Totals			3,686,920	594,016		40,798	2,451			
209	Little Buffalo Basin, *Hot Springs, Park*	Frontier *	1914	0			4,806	40,798	2,451			
210	Little Buffalo Basin, *Hot Springs, Park*	Embar	1943	1,430	1,573,807	287,508	0					
211	Little Buffalo Basin, *Hot Springs, Park*	Tensleep	1943	1,430	2,113,113	306,508	0					
212	Little Grass Creek, *Hot Sprgs.*	Totals						2,665	176			
213	Little Grass Creek, *Hot Sprgs.*	Frontier *	1917	0			500x	1,671	Abd			
214	Little Grass Creek, *Hot Sprgs.*	Muddy *	1944	0			320	994	176			
215	Little Laramie, *Albany*	Casper (Tensleep)	1948	60	59,732	39,806	0	F	F			
216	Little Polecat, *Park*	Frontier *	1922	0			500x	1,925	Abd			
217	Little Sand Draw, *Hot Springs*	Totals			87,099	87,099						
218	Little Sand Draw, *Hot Springs*	Embar	1949	160	x	x	0					
219	Little Sand Draw, *Hot Springs*	Tensleep	1949	160	x	x	0					
220	Lodgepole, *Sheridan*	Fall River	1949	20	1,586	1,167	0					
221	Lonetree Creek, *Sheridan*	Newcastle	1949	10	1,737	1,737	0					
222	Lost Soldier, *Sweetwater*	Totals			41,395,767	3,245,572		(F,L)	((F)			
223	Lost Soldier, *Sweetwater*	Frontier	1946	385			0					
224	Lost Soldier, *Sweetwater*	Muddy, Dakota, Lakota	1923-3	385	21,656,542	162,695	0	(F,L)	(F)			
225	Lost Soldier, *Sweetwater*	Sundance	1926	160			0					
226	Lost Soldier, *Sweetwater*	Tensleep	1930	1,100	16,435,087	982,729	0					
227	Lost Soldier, *Sweetwater*	Madison	1948	900	2,547,077	1,497,132	0					
228	Lost Soldier, *Sweetwater*	Cambrian	1948	800	757,061	603,016	0					
229	Lost, *Natrona*	Frontier *	1921	0			x	(F)	Abd			
230	Mahoney, *Carbon*	Totals			2,613,531	145,630		58,837	60			
231	Mahoney, *Carbon*	Dakota *	1919	0			600					
232	Mahoney, *Carbon*	Sundance *	1925	0			1,600					
233	Mahoney, *Carbon*	Tensleep	1930	400	2,613,531	145,630	0					
234	Mahoney, East, *Carbon*	Totals			107,024	0		36,743	283			
235	Mahoney, East, *Carbon*	Dakota *	1923	0			500					
236	Mahoney, East, *Carbon*	Sundance *	1925	0			800					
237	Mahoney, East, *Carbon*	Tensleep	1940	80	107,024	S.I.	0					
238	Maverick Springs, *Fremont*	Phosphoria	1917	1,345	3,564,426	113,698	0					
239	Meadow Creek, No., *Johnson*	Steele (Sussex sd)	1949	40	924	924	0					
240	Midway, *Natrona*	Totals			168,466	38,863	0					
241	Midway, *Natrona*	Frontier	1931	40	x	x	0					
242	Midway, *Natrona*	Muddy-Dakota	1932	280	x	x	0					
243	Moorcroft, *Crook*	Newcastle	1887	0x	800x	0	0					
244	Mule Creek (East) *Niobrara*	Totals			2,348,904	44,471						
245	Mule Creek, *Niobrara*	Lakota	1919	290	x	x	0					
246	Mule Creek, *Niobrara*	Nanneluse	1930	10x	(minor) x	x	0					
247	Mule Creek, West, *Niobrara*	Totals			138,942	4,460						
248	Mule Creek, *Niobrara*	Fall River, Lakota	1927	90	128,961	4,460	0					
249	Mule Creek, *Niobrara*	Nanneluse	1934	0x	9,981	Abd	0					
250	Murphy Dome, *Hot Springs*	Tensleep	1949	80	0	0	0					
251	Nash Creek-Skull Creek, *Sheridan*	Newcastle	1943-6	2,010	3,148,146	1,707,272	20x	(F,L)	(F,L)			
252	Muskrat, *Fremont*	Totals						23,581	602			
253	Muskrat, *Fremont*	Frontier *	1928	0			720	x	602			
254	Muskrat, *Fremont*	Lakota *	1937	0			0x	x	Abd			
255	Muskrat, East, *Fremont*	Frontier *	1945	0			160	97	Abd			
256	Nesbet, *Washakie*	Embar	1947	570	681,744	307,102	0	(L)	(L)			
257	Newcastle, *Weston*	Newcastle	1941	0x	250	0	0					
258	Natches, *Natrona*	Tensleep	1923	420	1,155,861	130,451	0	(F)	(F)			
259	Oil Mountain, *Natrona*	Tensleep	1945	40	0	S.I.	0					
260	Oil Springs, *Carbon*	Totals						10,804	1,915			
261	Oil Springs, *Carbon*	Dakota *	1945	0			120	x	x			
262	Oil Springs, *Carbon*	Sundance *	1938	0			160	x	x			
263	Oregon Basin, *Park*	Totals entire structure			47,389,664	1,600,606		8,081	428			
264	Oregon Basin, *North Dome*	Totals			20,701,389	694,256						
265	Oregon Basin, *North Dome*	Cloverly *	1912	0			450					
266	Oregon Basin, *North Dome*	Embar	1927	3,130	20,403,969	689,122	0					
267	Oregon Basin, *North Dome*	Tensleep	1927	3,130			0					
268	Oregon Basin, *North Dome*	Madison	1944	619	297,420	45,134	0					
269	Oregon Basin, *South Dome*	Totals			26,688,275	906,350						
270	Oregon Basin, *South Dome*	Frontier, Cloverly *	1912	0			40					
271	Oregon Basin, *South Dome*	Embar	1927	4,800	25,849,498	762,032	0					
272	Oregon Basin, *South Dome*	Tensleep	1927	4,800			0					

LINE NUMBER	NUMBER OF WELLS[e]			WELLS PRODUCING[f] DEC. 1949			RESERVOIR PRESSURE LB PER SQ. INCH		SECONDARY RECOVERY[g]	CHARACTER OF OIL[h]		PRODUCING FORMATION					DEEPEST ZONE TESTED[n] TO END OF 1949	
	COMPLETED TO END 1949	1949		OIL		GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT.[k]	PROD. THICKNESS AVG. FT. / NET	STRUCTURE[m]	NAME	DEPTH OF HOLE, FT
		COMPLETED	ABANDONED	FLOWING	ARTIFICIAL LIFT													
194	8	0	0	0	0	0	510					S		550-1,370	25			
195	3	0	0	0	1	0				25	2.7	L S		3,340	25			
196	290	0	4	53	148	1			U							D	Deadwood	6,256
197	54	0	0	2	52	1	1,300			45	.1	S		3,200	25			
198	90	0	1	23	37	0			P	47	.1	S		1,800	54			
199	146	0	3	0	109	0				42	.1	S		4,500-5,200	60			
200	11	0	0	1	8	0	1,272		U	45	.1	S		3,900	33	D	Madison	6,434
201	45	1	1	0	25	0										D	Amsden	2,553
202	29	1	1	0	20	0				24	3.0	L		1,755	20			
203	16	0	0	0	5	0				23	3.0	S		1,700	50			
204	1	1	0	0	1	0				41		S		3,870	30	M Fx	Minnelusa	5,182
205	22	4	0	9	11	0			U							D	Madison	6,531
206	18	1	0	7	10	0	1,468			43	.1	S		3,800	33			
207	4	3	0	2	1	0				34	.7	S	5,200	5,750	13-25			
208	38	0	0	0	24	8			U							D[ee]	Madison	5,944
209	14	0	0	0	0	8	380	282				S		1,500	Var			
210	14	0	0	0	14	0	1,721			21	3.3	L		4,566	30			
211	10	0	0	0	10	0				20	3.4	S		4,650	100			
212	3	0	1	0	0	1			U							D	Madison	6,632
213	2	0	1	0	0	0	500					S		2,560	50			
214	1	0	0	0	0	1	1,180					S		3,580	28			
215	5	0	0	0	5	0				18	3.3	S		3,725	25	D	Casper	3,961
216	1	0	1	0	0	0	1,100					S		3,905	50	D f	Tensleep	6,929
217	4	4	0	3	1	0										D fx	Tensleep	6,425
218	2	2	0	2	0	0	2,300			37	L 1	L		5,925	90			
219	2	2	0	1	1	0	2,416			36	L 2	S		6,105	70			
220	2	2	0	0	2	0				36		S		6,720		M	Spearfish	7,258
221	1	1	0	0	1	0				41		S		7,288	14	M	Morrison	7,718
222	127	2	0	0	62	1										D	Pre-Cambrian	7,323
223	35	0	0									S		400	90			
224	37	0	0	0	27	1			C	30	.3	S		1,400	45			
225	21	0	0											1,900	90			
226	25	1	0	0	26	0	1,750	875		35	1.2	S		4,880	130			
227	6	0	0	0	6	0				35	L 1	L		4,930	110			
228	3	1	0	0	3	0				35	L 1	S		5,820	40			
229	1	0	0	0	0	0						S		2,070	20		Frontier	2,601
230	24	0	0	0	9	3			U							D	Cambrian	5,366
231	2	0	0	0	0	0	820	25				S		2,490	20			
232	10	0	0	0	0	3	1,160	25				S		2,830	35			
233	12	0	0	0	9	0				34	1.3	S		4,480	40			
234	14	0	0	0	0	8										D	Madison	5,344
235	4	0	0	0	9	2	710	30				S		2,680	20			
236	8	0	0	0	0	6	1,040	30				S		2,745	30			
237	2	0	0	0	0	0				44	.6	S		4,290	25			
238	46	0	0	0	40	0				22	3.0	L		1,425	15	D	Bighorn	3,228
239	1	1	0	1	0	0				40		S		3,918	60	M Fx	Steele	4,513
240	4	0	0	0	3	0										D	Madison	8,430
241	2	0	0	0	1	0				28	.1	S		5,130	11			
242	2	0	0	0	2	0				31	.2	S		5,840	20			
243	7	0	0	0	0	0				22		S		725	45	M	Deadwood	3,511
244	41	0	0	0	40	0										D	Minnelusa	3,837
245	40	0	0	0	40	0				32	.1	S		1,285	31			
246	1	0	0	0	0	0				26	2.4	S L		3,160	23			
247	28	0	0	0	16	0			U							D	Paleozoic	3,047
248	26	0	0	0	16	0				35	.1	S		200±	12			
249	2	0	0	0	0	0				31	1.0	Shs		2,665	3			
250	1	1	0	0	0	0				34		S		4,364	90	D	Madison	5,280
251	203	77	3	20	177	0				34-42	.1	S	2,900	5,230	10	M T	Spearfish	4,912
252	5	0	1	0	0	2			U							A	Madison	8,112
253	3	0	0	0	0	2	1,625					S		4,280	25			
254	2	0	1	0	0	0	2,200					S		5,400	25			
255	1	0	1	0	0	0						S		3,000	35	A	Morrison	4,585
256	2	0	0	2	0	0	4,307	2,815	U	41	1.9	L		9,990	30	D	Madison	10,990
257	1	0	0	0	0	0				22	.1	S		560	17	M T	Greenhorn	620
258	11	0	0	0	8	1				22	1.7	S		2,815	35	D	Madison	3,527
259	1	0	0	0	0	0			U	12	4.8	S		2,665	30	A	Deadwood	3,416
260	5	0	0	0	0	5										A f	Chugwater	2,717
261	2	0	0	0	0	2	682	375				S		1,600	100			
262	3	0	0	0	0	3	1,100	842				S		2,200	85			
263	196	11	0	0	179	2			U									
264	75	6	0	0	65	1										D f	Madison	4,330
265	2	1	0	0	0	1	1,250					S		1,410	30			
266	56 (60)	2	0	0	50	0	700			23	2.9	L		3,745	36			
267	14	2	0	0	13	0	700			23	2.8	S		3,550	50			
268	3	1	0	0	2	0				18	3.4	L		3,730	60			
269	121	5	0	0	114	1										D f	Pre-Cambrian	6,434
270	3	0	0	0	0	1	520-325					S		1,150±	10-20			
271	83	1	0	0	80	0	1,352			21	3.2	L		3,580	35			
272	23	2	0	0	23	0				21	3.3	S		4,000	60			

TABLE I - CONTINUED OIL AND GAS PRODUCTION STATISTICS FOR WYOMING

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl	
				AREA PROVED ACRES	BARRELS TO END OF 1949	BARRELS DURING 1949	AREA PROVED ACRES	MILLION CU FT[c] TO END OF 1949	MILLION CU FT[c] DURING 1949		TO END OF 1949	DURING 1949
273	Oregon Basin, *South Dome*	Madison	1943	1,940	838,777	144,318	0					
274	Osage, *Weston*	Belle Fourche	1919	6,840	6,144,513	115,289	0	(F,L)	(F,L)			
		Newcastle	1920									
275	Pedro, *Weston*	Belle Fourche	1922	440	11,332	359	0					
276	Pilot Butte, *Fremont*	Totals			3,076,069	389,616						
277	Pilot Butte, *Fremont*	Cody	1916	200	652,666	8,654	0					
278	Pilot Butte, *Fremont*	Muddy	1931	320	7,861	7,861	160	x	(F) 42			
279	Pilot Butte, *Fremont*	Phosphoria	1942	80	2,415,542	293,101	10					
280	Pilot Butte, *Fremont*	Tensleep	1942	240			10					
281	Pine Mountain, *Natrona*	Tensleep *	1914	0x	6,354	0	80	102	17			
282	Pitchfork, *Park*	Totals			738,024	222,593						
283	Pitchfork, *Park*	Embar-Tensleep	1930	140	x	x	0					
284	Pitchfork, *Park*	Madison	1948	40	x	x	0					
285	Plunkett, *Fremont*	Mowry	1909	40	17,832	Abd	0					
286	Poison Spider, *Natrona*	Totals			1,446,838	62,175						
287	Poison Spider, *Natrona*	Muddy	1948	80	x	x	0					
288	Poison Spider, *Natrona*	Sundance	1917	480	x	x	480	5,552	(F)			
289	Poison Spider, *West, Natrona*	Totals			259,366	165,477		55	48			
290	Poison Spider, *West, Natrona*	Wasatch	1948	319	131,278	111,287	0	40	33			
291	Poison Spider, *West, Natrona*	Frontier	1948	350	127,118	54,190	0	15	15			
292	Powder River, *Natrona*	Totals			0	0		(F) 41	0			
293	Powder River, *Natrona*	Frontier *	1930	0			200					
294	Powder River, *Natrona*	Sundance *	1944	0			200					
295	Quealy, *Albany*	Totals			3,523,332	367,574						
296	Quealy, *Albany*	Dakota Group	1934	212	2,971,978	244,029	0	(F)	(F)			
297	Quealy, *Albany*	Sundance	1937	60			0					
298	Quealy, *Albany*	Casper (Tensleep)	1947	255	551,154		0					
299	Red Springs, *Hot Springs*	Madison	1919-42	900	14,190	S.I.	0					
300	Rex Lake, *Albany*	Dakota Group	1923	280	482,698	45,638	0	(F)	(F)			
301	Riverton, *Fremont*	Tensleep	1949	160	85,626	85,626	0	(L)	(L)			
302	Rock Creek, *Carbon*	Totals			27,613,416	734,732		x	x			
303	Rock Creek, *Carbon*	Dakota group	1918	1,740	x	x	0					
304	Rock Creek, *Carbon*	Sundance	1935	200	x	x	0					
305	Rocky Ford, *Crook*	Minnelusa	1909	120x	0x	0	0					
306	Sage Creek, *Big Horn*	Madison	1948	80	9,131	S.I.	0					
307	Sage Creek, *Fremont*	Chugwater	1916	40	2,000x	0	0					
308	Sage Creek, No., *Fremont*	Phosphoria	1947	40	3,632	98	0					
309	Sage Spring Creek, *Natrona*	Dakota	1949	200	15,702	15,702	0	309,327	3,326	(F)		
310	Salt Creek, *Natrona*	Totals			335,193,600	3,939,010						
311	Salt Creek, *Natrona*	Upper Shale	1906		3,873,674	21,917						
312	Salt Creek, *Natrona*	Frontier(1,2,3 Wall Cr)	1908	21,450	294,216,709	3,066,168						
			1917									
313	Salt Creek, *Natrona*	"Lakota" shale	1925		2,773,543	80,701						
314	Salt Creek, *Natrona*	Lakota sd.	1921	2,000	18,195,331	182,512						
315	Salt Creek, *Natrona*	Morrison	1929	10	151,570	1,137						
316	Salt Creek, *Natrona*	Sundance (2nd-3rd sds)	1925	900	11,052,084	371,805						
317	Salt Creek, *Natrona*	Tensleep	1930	1,005	4,930,689	234,770						
318	Salt Wells, *Sweetwater*	Dakota *	1949	0			600x	0	S.I.			
319	Sand Creek, *Washakie*	Frontier	1947	685	489,884	349,669	685	(F) 113	(F) 113			
320	Sand Draw, No., *Fremont*	Frontier *	1946	0			190	2,130	794			
321	Seven Mile, *Albany*	Muddy	1947	200	20,356	9,299	0					
322	Shannon, *Natrona*	Steele (Shannon sd)	1889	55	53,441	Abd	0					
323	Shannon, *Converse*	White River *	1936	40	1,337	0	180x	0	0			
324	Sheep Creek, *Fremont*	Phosphoria	1935	80	19,021	S.I.	0					
325	Sheldon, *Fremont*	Totals			256,973	70,525						
326	Sheldon, *Fremont*	Frontier *	1925	0			40	(F)	(F)			
327	Sheldon, *Fremont*	Phosphoria	1945	80	x	x	0					
328	Sheldon, *Fremont*	Tensleep	1948	40	x	x	0					
329	Sherard, *Carbon*	Totals						672	20			
330	Sherard, *Carbon*	Frontier *	1942	0			50x	x	Abd			
331	Sherard, *Carbon*	Dakota-Lakota *	1942	0			60	x	29			
332	Shoshone, *Park*	Embar-Tensleep	1915-29	180	302,057	99,107	0					
333	Shoshone, No., *Park*	Embar	1948	40x	2,526	(Abd) 1,180	0					
334	Silver Tip, *Park*	Totals			637,900	442,623						
335	Silver Tip, *Park*	Frontier	1948	200	68,712	43,674	0	(F,L)	(F,L)			
336	Silver Tip, *Park*	Embar-Tensleep	1948	400	569,188	398,949	0	(F,L)	(F,L)			
337	Simpson Ridge, *Carbon*	Wasatch (Quealy sd)	1923	160	228,574	674	0					
338	Skull Creek, *Sheridan*	Newcastle	1946-8	(Included with Nash Creek)								
339	South Fork, *Washakie*	Embar	1947	1,200	154,719	63,541	0					
340	Spence, *Big Horn*	Amsden-Madison	1944	100	28,404	2,774	0					
341	Spindletop, *Natrona*	Totals			64,416	S.I.						
342	Spindletop, *Natrona*	Sundance	1922	80	x	0	0					
343	Spindletop, *Natrona*	Tensleep	1944	80	x	0	0					
344	Spring Creek, *Park*	Totals			106,365	S.I.						
345	Spring Creek, *Park*	Embar	1929	480	x	0	0					
346	Spring Creek, *Park*	Tensleep	1929	480	x	0	0					
347	Spring Creek, *Park*	Madison	1947	440	x	0	0					
348	Spring Valley, *Uinta*	Aspen, Bear River	1900	320	206,300	1,120	0	799	245	(F)		
349	Steamboat Butte, *Fremont*	Totals			12,363,989	2,219,054		799	245			
350	Steamboat Butte, *Fremont*	Frontier *	1945	0			400					
351	Steamboat Butte, *Fremont*	Lakota	1944	0x	12,972	Abd	0					
352	Steamboat Butte, *Fremont*	Nugget	1943	320	3,441,725x	195,772x	0					
353	Steamboat Butte, *Fremont*	Phosphoria	1948	40	79,738x	24,402x	0					
354	Steamboat Butte, *Fremont*	Tensleep	1944	1,500	8,829,564x	1,998,880x	0					
355	Sulphur Creek, *Uinta*	Bear River	1942	80	14,915	1,632	0					

LINE NUMBER	NUMBER OF WELLS[a]			WELLS PRODUCING[f] DEC. 1949			RESERVOIR PRESSURE LB. PER SQ. INCH		SECONDARY RECOVERY[g]	CHARACTER OF OIL[h]		PRODUCING FORMATION					DEEPEST ZONE TESTED[n] TO END OF 1949	
	COMPLETED TO END 1949	1949		OIL		GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT.[k]	PROD. THICKNESS AVG. FT. / NET	STRUCTURE[l]	NAME	DEPTH OF HOLE, FT.
		COMPLETED	ABANDONED	FLOWING	ARTIFICIAL LIFT													
273	12	2	0	0	11	0				18	3.7	L		4,380	300			
274	635	13	x	0	325	0				39	.1	S		2,930-3,320	10		Ss.T.	Minnelusa	2,592
275	22	0	0	0	7	0				40	.2	S,Sh		200	10		Ss.T.	Niobrara	840
276	39	16	0	1	25	0											D f	Madison	7,398
277	38	8	0	0	11	0				38	.1	Sh		735	10				
278	50	3	0	1	0	2				46	.1	Sd		3,440	23 - 40				
279	8	3	0	0	5	0				35	1.5	L		5,945	30				
280	9	5	0	0	4	0	2,871			35	1.5	S		6,250	25				
281	8	0	0	0	0	0	460			19	.3	S		1,800	30		D	Leadwood	3,127
282	7	0	0	0	7	0			U								A	Madison	4,468
283	6	0	0	0	6	0				18	1.3	L,S		3,575	130				
284	1	0	0	0	1	0				15	3.7	L		4,250	30				
285	17	0	0	0	0	0				41	-.1	Sh		450	5		N	Tensleep	4,795
286	45	0	0	0	31	0											D	Pre-Cambrian	4,119
287	3	0	0	0	2	0						S		500	10				
288	42	0	0	0	29	0	540	10		20	3.1	S		1,200	60				
289	2	0	0	2	0	0			U								D	Frontier	14,309
290	1	0	0	1	0	0	3,732			44	.1	S		9,230	50				
291	1	0	0	1	0	0	5,823			44	.1	S		14,194	50				
292	2	0	0	0	0	0											D	Madison	4,889
293	1	0	0	0	0	0	530					S		1,314	40				
294	1	0	0	0	0	0	1,115					S		2,489	30				
295	25	1	0	0	21	0											D	Pre-Cambrian	6,165
296	17	0	0	0	13	0				31	.2	S		3,300	80				
297																			
298	8	1	0	0	8	0	1,325			23		S		5,400	140				
299	2	0	0	0	0	0			U	11	4.0	L		900	40		D	Madison	1,095
300	8	0	0	0	5	3				35	.1	S		3,700	25		D	Casper	6,103
301	1	1	0	1	0	0	2,500			43	.7	S		11,665	110		D	Tensleep	11,884
302	86	0	0	0	36	0			G								D	Fountain	5,716
303	73	0	0	0	36	0				37	-.1	S		3,000	100				
304	13	0	0							37		S		3,500	50				
305	4	0	0	0	0	0				15	4.2	S		175*	6		S	Pahasapa	1,323
306	2	0	0	0	0	0			U	18		L		3,356	20		D	Pre-Cambrian	5,738
307	2	0	0	0	0	0				21	3.3	S		710	20		A	Madison	1,958
308	1	0	0	0	0	0				21	3.3	L		2,105	20		D	Tensleep	2,525
309	2	2	0	0	2	0			U	35		S		7,310	20		N	Mahsun	9,539
310	2,274	8	26	11	1,061	0			U								D f	Pre-Cambrian	5,420
311	x	1	0	0	13	0								370-2,310	41				
312	x	7	26	0	973	0			C					934-2,849	59				
313	x	0	0	0	14	0								1,576-2,450	41				
314	x	0	0	0	34	0								2,380-2,727	41				
315	x	0	0	0	1	0								2,592	3				
316	x	0	0	0	36	0								2,785-3,316	37				
317	17	0	0	11	0	0								3,775-3,980	83				
318	1	1	0	0	0	0	2,250		U			S		6,260	24		D f	Nugget	7,215
319	12	0	0	9	0	1	2,980		U, G			S		6,750	35		D	Madison	10,002
320	2	0	0	0	0	2	620		U			S		3,865	34		A F	Tensleep	8,956
321	1	0	0	0	1	0			U	34	.2	S		5,830	14		D	Jefn	6,776
322	43	0	0	0	0	0				24	.2	S		730	30		M f	Frontier	3,245
323	10	0	0	0	0	0	145			25	.1	S		450	10		M U	Pre-Cambrian	2,940
324	3	0	0	0	0	0				23	2.8	L		2,145	15		A	Tensleep	3,290
325	3	0	0	0	2	0											D	Madison	7,984
326	1	0	0	0	0	0	800					S		2,620	10				
327	1	0	0	0	1	0				35	.9	L		6,245	30				
328	1	0	0	0	1	0				35	1.1	S		6,765	50				
329	3	0	0	0	0	1											D(2)	Tensleep	5,185
330	1	0	0	0	0	0	965							2,315	15				
331	2	0	0	0	0	1	1,045							2,830	20				
332	4	1	0	0	4	0				19	3.4	L,S		4,565	60		A	Madison	5,503
333	1	0	1	0	0	0				18	3.5	L		3,705	30		A f	Madison	4,842
334	14	6	0	13	0	0											M F	Madison	9,507
335	5	0	0	5	0	0	2,122			43	1.9	S		5,965	45				
336	9	6	0	8	0	0	3,685			46	1.1	L,S		8,835	80				
337	8	0	0	0	0	0				22	-.1	S		665	20		D	Frontier	6,931
338																			
339	2	1	0	0	2	0	4,255		U	29	1.8	L		10,165	40		D	Madison	10,900
340	8	0	0	0	6	0				19	2.7	L		495	15		D	Cambrian	2,400
341	6	0	0	0	0	0											D	Aneden	2,807
342	5	0	0	0	0	0				20	3.3	S		1,025	40				
343	1	0	0	0	0	0				18	3.4	S		2,225	30				
344	6	0	0	0	0	0			U								A	Madison	5,410
345	3	0	0	0	0	0				15	3.1	L		4,370	30				
346	2	0	0	0	0	0				15	3.9	S		4,045	50				
347	1	0	0	0	0	0				12	4.4	L		4,500	90				
348	30x	0	0	0	8	0				40	.1	S		540-2,330	10		M U	Bear River x	2,555 x
349	30	2	0	0	28	1											A f	Bighorn	8,000
350	1	0	0	0	0	1	1,020					S		3,250	20				
351	1	0	0	0	0	0				38	.1	S		4,500	20				
352	8	0	0	0	8	0	2,082			26	2.6	S		5,245	60				
353	1	0	0	0	1	0				32	1.5	L		6,745	30				
354	19	2	0	0	19	0	2,945			29	2.1	S		6,820	145				
355	4	0	0	0	3	0				28	.1	S		660	15		M U	Morrison x	4,325

TABLE I – CONTINUED OIL AND GAS PRODUCTION STATISTICS FOR WYOMING

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION AREA PROVED ACRES	OIL PRODUCTION BARRELS TO END OF 1949	OIL PRODUCTION BARRELS DURING 1949	GAS PRODUCTION AREA PROVED ACRES	GAS PRODUCTION MILLION CU FT TO END OF 1949	GAS PRODUCTION MILLION CU FT DURING 1949	GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl TO END OF 1949	CONDENSATE PRODUCTION Thousands of Bbl DURING 1949
356	Sunshine, So., *Park*	Tensleep	1928	160	3,338	312	0					
357	Sunshine, So., *Park*	Embar	1926	200	68,589	21,293	0					
358	Sussex, *Johnson*	Totals			324,772	28,805		(F,L)	(F,L)			
359	Sussex, *Johnson*	Shannon	1949	150	19,455	19,455	0					
360	Sussex, *Johnson*	Lakota	1948	320	305,317	269,350	0					
361	Table Rock, *Sweetwater*	Fort Union *	1946	0			80	(F) 13	0			
362	Teapot, *Natrona*	Totals			3,549,238	S.I.		5,163	S.I.			
363	Teapot (Naval Res. No. 3)	Shannon, Niobrara-Carlile	1922	x	500,000x							
364	Teapot (Naval Res. No. 3)	Frontier	1922	3,000	3,049,238							
365	Teapot, *Natrona* (outside Res.)	Niobrara	1922	40	154,015	3,037	0					
366	Thornton, *Crook, Weston*	Carlile	1915	0x	463x	Abd	0					
367	Torchlight, *Big Horn*	Totals			783,752	243,015						
368	Torchlight, *Big Horn*	Mowry	1913	600	199,284	Abd	0					
369	Torchlight, *Big Horn*	Tensleep	1947	200	584,468	243,015	0					
370	Torchlight, *Big Horn*	Madison	1948	360			0					
371	Wagonhound, *Hot Springs*	Embar	1944	120	246,208	42,742	0					
372	Wakeman Flats, *Crook*	Carlile	1919	80x	Non-com.	abd	0					
373	Walker Dome, *Hot Springs*	Frontier *	1930	0			160	S.I.				
374	Warm Springs, *Hot Springs*	Embar	1917	180	632,634	28,709	0					
375	Waugh, *Hot Springs*	Embar	1934	100	439,140	83,842	0					
376	Wertz, *Carbon, Sweetwater*	Totals			18,538,456	1,894,735		67,478 [1]	359	(F)		
377	Wertz, *Carbon, Sweetwater*	Frontier *	1925	0			80	1,250				
378	Wertz, *Carbon, Sweetwater*	Muddy *	1930	0			500	36,800				
379	Wertz, *Carbon, Sweetwater*	Cloverly *	1930	0	9,002	0	500	26,200				
380	Wertz, *Carbon, Sweetwater*	Sundance *	1929	0			100	2,600				
381	Wertz, *Carbon, Sweetwater*	Tensleep	1936	650	17,206,367	1,302,726	0					
382	Wertz, *Carbon, Sweetwater*	Amsden	1948	400	299,802	138,780	0					
383	Wertz, *Carbon, Sweetwater*	Madison	1948	550	979,460	529,406	0					
384	Wertz, *Carbon, Sweetwater*	Cambrian	1948	200	43,825	23,823	0					
385	Wildhorse Butte, *Hot Springs*	Embar	1948	40	1,248	280	0					
386	Winkleman, *Fremont*	Totals			2,504,254	472,177						
387	Winkleman, *Fremont*	Morrison *	1917	0			80					
388	Winkleman, *Fremont*	Phosphoria	1948	560	x	x	0					
389	Winkleman, *Fremont*	Tensleep	1944	560	x	x	0					
390	Worland, *Washakie*	Embar	1946	6,255	4,995,247	3,084,461	0	(L)	(L)			
391	Zimmerman Butte, *Hot Springs*	Totals			521,033	82,072						
392	Zimmerman Butte, *Hot Springs*	Frontier	1946	10	113	0	16	(F)	(F)			
393	Zimmerman Butte, *Hot Springs*	Embar	1945	230	520,900	82,072	0					
		Totals, Wyoming		108,933	855,622,425	47,884,053	53,441	316,622	179,592			

ABBREVIATIONS USED

F = Unmeasured Gas for field or local use.

L = Gas from oil wells (mostly sour) is lost.

U under Secondary Recovery = unit operation.

C = Condensate. Included in oil production figures in some reports. *

S.I. = Shut-in.

Abd = Abandoned.

* Total condensate reported for state is amount produced in recent years by gas wells in fields indicated. Field totals not released.

LINE NUMBER	NUMBER OF WELLS[2]			WELLS PRODUCING[1] DEC. 1949			RESERVOIR PRESSURE LB PER SQ INCH		SECONDARY RECOVERY[4]	CHARACTER OF OIL[8]		PRODUCING FORMATION					DEEPEST ZONE TESTED[9] TO END OF 1949	
	COMPLETED TO END 1949	1949		OIL		GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[3]	POROSITY PER CENT[7]	DEPTH TO TOP OF PRODUCING ZONE FT.[6]	PROD. THICKNESS AVG. FT.[7] NET	STRUCTURE[10]	NAME	DEPTH OF HOLE, FT
		COMPLETED	ABANDONED	FLOWING	ARTIFICIAL LIFT													
356	2	1	0	0	0	0				15	3.7	S		3,665	50	D	Amsden	3,780
357	2	0	0	0	1	0				18	3.1	L		2,480	30	D	Tensleep	3,064
358	8	7	0	8	0	0			U							FIps	Chugwater	8,424
359	2	2	0	2	0	0						S		4,530	28			
360	6	5	0	6	0	0	3,470			39	.3	S		7,535	26			
361	2	0	0	0	0	0	1,225		U			S		3,300	20	D	Lewis	4,106
362	73	0	0	0	0	0										D f	Frontier	3,340
363	13	0	0	0	0	0								9504				
364	60	0	0	0	0	0				36	.1	S		2,835	60			
365	4	1	0	0	4	0				34	.1	S h		2,440			Frontier	3,605
366	15	0	0	0	0	0				40	.1	S		600	35	T	Grameros	1,050
367	99	0	0	0	12	0										D	Madison	4,165
368	87	0	0	0	0	0				40	.1	S		525	50			
369	15	0	0	0	5	0	1,606			35	1.6	S		3,115	20			
370	17	0	0	0	7	0	1,900±			20	2.6	L		3,540	70			
371	3	0	0	0	3	0			U	29	1.4	L		4,280	16	D	Tensleep	4,760
372	5	0	0	0	0	0				39	.1	S		505	12	T	"Dakota"	2,159
373	1	0	0	0	0	0	980					S		3,130	15	D	Cloverly	4,412
374	39	0	0	0	16	0				18	3.5	L		925	40	D	Madison	2,207
375	4	0	0	0	3	0			U	28	1.7	L		3,705	39	D	Madison	4,705
376	39	1	0	0	21	2			U							D	Pre-Cambrian	7,785
377	1	0	0	0	0	1	810					S		2,260	30			
378	1	0	0	0	0	0	1,800					S		3,435	60			
379	5	0	0	0	0	1	1,350					S		3,540	50			
380	1	0	0	0	0	0	1,520					S		4,100	40			
381	24[11]	0	0	0	14	0	2,900	2,140	P	35	1.3	S		6,030	170			
382	2[12]	0	0	0	2	0				35	1.2	S		6,570	40			
383	4	1	0	0	4	0				35	1.3	L		6,630	120			
384	1	0	0	0	1	0				36	1.3	S		7,515	35			
385	2	1	0	0	0	0				14		L		1,105	30	T	Madison	2,070
386	11	0	0	0	9	1										D	Pre-Cambrian	5,675
387	2	0	0	0	0	1	50					S		535	30			
388	1	0	0	0	1	0	935			25		L		2,845	75			
389	8	0	0	0	8	0	1,121			24	2.9	S		3,020	180			
390	24	12	0	21	0	0	4,580			38	1.3	L		10,165	50	D	Threeforks	11,379
391	8	1	1	0	5	1										A	Embar	4,320
392	2	1	0	0	0	1	400			35	.2	S		1,090	10			
393	6	0	1	0	5	0				25	2.6	L		4,300	25			
	7,129	335	59	254	3,685	172												

FOOTNOTES FOR ENTIRE TABLE

(1) Colorado side only.

(2) Well abandoned after drilling

(3) Production by sands does not equal total runs.

(4) 3 injection and 3 shut-in wells.

(5) Dual completions counted as oil wells or under one producing formation.

(6) Montana side only.

(7) North Dakota side only.

(8) Oil produced during testing, not sold, shut-in.

(9) Does not include dual completions.

(10) Includes Embar-Tensleep wells.

(11) Includes dual completions.

(12) Wyoming side only.

IMPORTANT WILDCATS DRILLED IN 1949

LINE NUMBER	COUNTY AND LOCALITY	LOCATION SEC.	TWP.	RGE.	TOTAL DEPTH	FORMATION	DEEPEST HORIZON TESTED	DRILLED BY	INITIAL PRODUCTION PER DAY OIL, U.S. BBL.	GAS, MILLIONS CU. FT.	CONDENSATE U.S. BBL.	REMARKS
	COLORADO	6TH P. M.										
1	*Rio Blanco, Buford*	25	1 N	91 W	3,634	Pen ?	Mis	Siegel, et al				N F W, Dry
2	*Morgan, Fort Morgan*	6	2 N	56 W	6,001	Pierre	Morrison ?	Murphy, et al				N F W, Dry
3	*Routt, Oak Creek*	2	3 N	86 W	6,747	Iles	Moenkopi	R. E. Havenstrite	330			N F W, Shinarump 6672'
4	*Rio Blanco, Seely*	26	3 N	90 W	4,002	Mancos	Mancos	G. L. Beasor				N F W, Dry
5	*Moffat, Coles Dome*	2	3 N	92 W	3,314	Mancos	Dakota	W. H. Pitts				N F W, Dry
6	*Moffat, Coles Dome*	2	3 N	92 W	3,901	Mancos	Entrada	W. H. Pitts				N F W, Dry
7	*Moffat, Cossard*	13	4 N	93 W	4,559	Mancos	Entrada	Lowell & Voltz				N F W, Dry
8	*Moffat, Elk Springs*	12	4 N	99 W	8,886	Mancos	Weber	Idaho-Col. Pet. Inc.				O P, Dry
9	*Larimer, Loveland*	30	5 N	68 W	5,436	Pierre	Dakota	Tyer F Race				N F W, Dry
10	*Moffat, Axial Basin*	17	5 N	94 W	3,420	Browns Park	Morgan	W. C. McBride, Inc.				N F W, Dry
11	*Routt, Iow Creek*	7	6 N	86 W	5,627	Mancos	Pen ?	Texas Co.				D P T, Dry
12	*Logan, Alexander Bl.*	6	7 N	53 W	5,275	Pierre	Dakota gr.	F. M. Manning				N F W, Dry
13	*Routt, No. Trull Creek*	4	7 N	85 W	2,307	Mancos	Triassic	W. E. Atkinson				N F W, Dry
14	*Logan, West Plains*	15	9 N	55 W	5,814	White River	Morrison ?	Midwest Drg. Co.				N F W, Dry
15	*Moffat, Iron Springs*	9	9 N	93 W	5,217	Wasatch	Fort Union	Utah-Vernal Oil Co.				N F W, Dry
16	*Moffat, Dry Mountain*	36	9 N	99 W	6,346	Green River	Fort Union ?	Brit. Amer. O.P. Co.				N F W, Dry
17	*Logan, Winston*	23	11 N	52 W	4,924	White River	Dakota gr.	Plains Expl. Co.				N F W, Dry
18	*Logan, Armstrong*	26	11 N	54 W	5,216	Pierre	Dakota	Plains Expl. Co.				N F W, Dry
19	*Moffat, Hiawatha*	27	12 N	100 W	4,503	Wasatch	Wasatch	Lion Oil Co.				O P, Dry
20	*Rio Blanco, W. Douglas Creek*	29	2 S	102 W	6,130	Williams Fork	Entrada	Pure Oil Co.				N F W, Dry
21	*Yuma, Jon's Acres*	24	4 S	48 W	3,650	Ogallala	Morrison	Ambassador Oil Co.				N F W, Dry
22	*Eagle, Brush Creek*	4	5 S	84 W	6,321	Permian	Pre-Cambrian	Champlin Pef. Co.				N F W, Dry
23	*Mesa, Asbury Creek*	14	9 S	101 W	4,223	Mancos	Pre-Cambrian	Amerada Pet. Corp.		1.6		NFW, Dakota 2,836'
24	*Lincoln, Hugo*	3	11 S	52 W	3,677	Pierre	Fuson	Siegel-Frontier				N F W, Dry
25	*Park, Hartsel*	30	12 S	74 W	6,162	Quaternary	Maroon	McDannald Oil Co.				N F W, Dry
26	*Park, Hartsel*	1	12 S	75 W	7,098	Quaternary	Morrison	McDannald Oil Co.				N F W, Dry
27	*Crowley, Tepee Buttes*	36	18 S	56 W	7,172	Pierre	Arbuckle	Gulf-Col. F & T Co.				N F W, Dry
28	*Pueblo, Rohr Gulch*	20	19 S	67 W	3,946	Niobrara	Pen ?	Hollandsworth, et al				N F W, Dry
29	*Crowley, Bib Creek*	11	20 S	58 W	7,524	Pierre	Arbuckle	J. B. Stoddard				N F W, Dry
30	*Las Animas, Tercio*	29	34 S	68 W	7,457	Pierre	Fountain	Skelly Oil Co.				N F W, Dry
		NEW MEXICO P. M.										
31	*Archuleta, Juanita*	2	33 N	2 W	2,611	Mesaverde	Dakota gr.	White & Duncan				N F W, Dry
32	*Montezuma, Yucca House*	1	34 N	17 W	4,075	Mancos	Chinle ?	Goldsworthy, et al				N F W, Dry
33	*Montezuma, Dove Creek*	1	38 N	19 W	6,158	Dakota	Paradox	H. E. & L. Drg. Co.				O P, Dry
34	*Montezuma, Dove Creek*	9	38 N	19 W	6,240	Dakota	Paradox	Western Nat. Gas. Co.				O P, Dry
35	*Montezuma, Dove Creek*	34	39 N	18 W	6,031	Dakota	Paradox	H. E. & L. Drg. Co.				O P, Dry
36	*Montrose, Horsefly*	14	48 N	13 W	5,035	Dakota	Cambrian ?	Pure Oil Co.				N F W, Dry
	MONTANA											
1	*Fallon, Plevna-101 Ranch*	18	5 N	60 E	1,230	Fox Hills	Judith River	Frank H. Becker		.4		OF, Judith R.1170'
2	*Wheatland, Shawnut*	24	7 N	18 E	4,354	Colorado	Madison	Mon-o-co Oil Corp.				N F W, Dry
3	*Rosebud, Sunatra*	5	9 N	34 E	6,006	Bearpaw	Madison	Texas Co.	98			NFW, Amsden 4,385'
4	*Musselshell, Devil's Pocket*	9	10 N	22 E	2,500	Colorado	Charles	Wm. M. Hanlon	50*	31.9		NFW, Amsden 1,481'*
5	*Musselshell, SE Howard Coulee*	2	10 N	28 E	4,545	Claggett	Kibbey	Texas Co.				N F W, Dry
6	*Musselshell, Melstone*	8	10 N	29 E	4,352	Judith River	Otter	Amerada Pet. Corp.				N P W, Dry
7	*Musselshell, Melstone*	21	10 N	29 E	4,428	Judith River	Big Snowy	Amerada Pet. Corp.	90			OF, Amsden 4,267'
8	*Musselshell, Melstone*	23	10 N	29 E	7,625	Judith River	Cambrian	Amerada Pet. Corp.	200	(A)		D P T, Dry, P B
9	*Musselshell, Raggerd Point*	3	11 N	29 E	4,774	Claggett	Kibbey	Texas Co.				O P, Dry
10	*Rosebud, SE Dagged Point*	21	11 N	31 E	6,011	Bearpaw	Madison	Klamath Oil Co.				N F W, Dry
11	*Rosebud, Primitive Dome*	6	11 N	34 E	2,561	Lance	Colorado	Primitive Oil Co.				N F W, Dry
12	*Rosebud, Primitive Dome*	6	11 N	34 E	2,583	Lance	Colorado	Primitive Oil Co.				N F W, Dry
13	*Rosebud, Primitive Dome*	7	11 N	34 E	4,530	Lance	Kootenai	Primitive Oil Co.				N F W, Dry
14	*Petroleum, Rattlesnake Butte*	27	13 N	28 E	4,670	Claggett	Kibbey	Ike W. Taylor				DPT, DMIL, Dry
15	*Garfield, SE of Cat Creek*	12	14 N	31 E	3,265	Colorado	Amsden	Allen Barnes				N P W, Dry
16	*Petroleum, Cat Creek*	11	15 N	29 E	1,944	Colorado	Ellis	Continental Oil Co.	264			DPt, Morrison 1,792'
17	*Garfield, Freedom Dome*	25	16 N	38 E	9,018	Fort Union	Cambrian	Gen. Pet. Corp.				N F W, Dry
18	*Petroleum, Roseleder Dome*	25	17 N	24 E	4,917	Colorado	Cambrian	Amerada Pet. Corp.				N F W, Dry
19	*Chouteau, Virgelle*	8	25 N	12 E	2,910	Colorado	Madison	Warena Oil Co.				N F W, Dry
20	*Valley, Hinsdale*	26	30 N	36 E	6,130	Judith River	Ordovician	Bassie Hunt Trust				N F W, Dry
21	*Hill, Laredo*	26	31 N	13 E	5,447	Bearpaw	Cambrian	Texas Co.				N F W, Dry
22	*Blaine, Bowes*	2	31 N	19 E	3,586	Judith River	Madison	Northern Ordnance	400			DPT, Ellis, 3,378'
23	*Phillips, Whitewater*	11	34 N	31 E	5,894	Quaternary	Cambrian	Texas Co.				N F W, Dry
24	*Hill, Cassady*	14	35 N	16 E	4,140	Claggett	Madison	Midwest Drg. Co.				N F W, Dry
25	*Teton, Dutton*	7	24 N	2 W	3,652	Colorado	Cambrian	Brit. Amer. O.P. Co.				N F W, Dry
26	*Teton, Agawam*	9	26 N	4 W	4,522	Colorado	Cambrian	Gen. Pet. Corp.				N F W, Dry
27	*Powders, William*	18	29 N	3 W	2,785	Eagle	Madison	Pilot Prod. Co.				N F W, Dry
28	*Powders, Cut Bank*	4	31 N	5 W	2,991	Two Medicine	Madison	Haggerty Oil Co.	10			OF, Ellis 2,980'
29	*Toole, Kevin-Sunburst*	12	34 N	4 W	1,865	Colorado	Madison	Hesla Oil Co.	22			OF, Madison 1,861'
30	*Toole, Cut Bank*	19	36 N	4 W	2,738	Two Medicine	Ellis	Texas Co.		7		OF, Cut Bank 2,710'
31	*Glacier, Coyote Springs*	31	36 N	6 W	3,414	Two Medicine	Madison	Union Oil Co.				N F W, Dry
32	*Glacier, Reagan*	15	37 N	7 W	6,259	Two Medicine	Devonian	Union Oil Co.	121	(A)		DPT, Dry, PB
33	*Glacier, Reagan*	29	37 N	7 W	3,963	Two Medicine	Madison	Union Oil Co.				O P, Dry
34	*Park, Mission Creek*	30	2 S	11 E	4,117	Eagle	Ellis	Richfield Oil (Mont.)				N F W, Dry
35	*Carter, Corral Creek*	15	4 S	57 E	5,310	Pierre	Charles	Amerada Pet. Corp.				N F W, Dry
36	*Carter, Whitetail Creek*	15	5 S	57 E	4,812	Pierre	Amsden	Amerada Pet. Corp.				N F W, Dry
37	*Carbon, McKay*	13	6 S	17 E	3,736	Lance	Lasata	Union Oil Co.				N F W, Dry
38	*Carbon, Jack Creek*	13	7 S	23 E	510	Colorado	Dakota	J. C. Shupe	25			NFW, Dakota 501'
39	*Carbon, Clark Fork*	26	9 S	22 E	9,446	Fort Union	Madison	Brit. Amer. O.P. Co.		2.2	31	DPT, Dakota 7,548'
40	*Big Horn, Ash Creek*	36	9 S	37 E	11,519	Fort Union	Cambrian	Shell Oil Co.				N F W, Dry

* Oil in Heath formation 1,846' plugged off.
(A) Completed in known producing formation.

IMPORTANT WILDCATS DRILLED IN 1949

LINE NUMBER	COUNTY AND LOCALITY	LOCATION SEC.	TWP.	RGE.	TOTAL DEPTH	FORMATION	DEEPEST HORIZON TESTED	DRILLED BY	INITIAL PRODUCTION PER DAY OIL BBL.	GAS MILLIONS	CONDENSATE OR BBL.	REMARKS
41	Carter, Hodge	34	9 S	55 E	3,545	Pierre	Dakota	Northern Ordnance				N F W, Dry
	UTAH											
		SALT LAKE MER.										
1	Garfield, Johns Valley	22	35 S	2 W	10,172	Wahsatch	Hermosa	California Co.				N F W, Dry
2	Uintah, Pine Ridge	7	3 S	30 E	3,508	Shinarump	Moss	Tide Water Assoc.				N F W, Dry
3	Uintah, Brush Creek	26	4 S	22 E	4,302	Mancos	Weber	Sun Oil Co.				N F W, Dry
4	Uintah, Naples	33	4 S	22 E	4,922	Mancos	Weber	Equity Oil Co.				N F W, Dry
5	Uintah, Naples	12	5 S	21 E	6,133	Mancos	Navajo	Calif.-Utah Oil Co.				N F W, Dry
6	Uintah, Vernal	33	5 S	21 E	7,884	Duchesne River	Wasatch	Carter Oil Co.				N F W, Dry
7	Uintah, Naples	4	5 S	22 E	5,900	Mancos	Weber	Baird & Hobbans				O P, Dry
8	Uintah, Ashley Valley	15	5 S	22 E	4,778	Mancos	Chinle	Crain & Griffith				O P, Dry
9	Uintah, Ashley Valley	18	5 S	23 E	6,439	Mancos	Weber	H. D. Moore, et al				N F W, Dry
10	Uintah, Jensen	20	5 S	23 E	4,447	Mancos	Weber	Utah-Vernal Oil Co.				N F W, Dry
11	Uintah, Hatter Creek	10	10 S	22 E	8,530	Uinta	Wasatch	Seaboard Oil Co.				N F W, Dry
12	Grand, Thompson	33	21 S	21 E	13,767	Mancos	Paradox	Pac. West-Equity				N F W, Dry
13	Grand, Green River	2	22 S	16 E	5,645	Morrison	Paradox	Amerada Pet. Corp.				N F W, Dry
14	Grand, Green River	2	22 S	16 E	5,896	Morrison	Paradox	Amerada Pet. Corp.				N F W, Dry
15	Grand, Salt Wash	32	22 S	17 E	5,046	Entrada	Paradox	Pac. West. Oil Corp.				N F W, Dry
16	Grand, Crescent	4	22 S	19 E	10,350	Mancos	Paradox	Gas Pongratz				NFW, (D&A), Dry
17	Grand, NE Salt Valley	2	23 S	20 E	3,036	San Rafael gr.	Paradox	Pure Oil Co.				N F W, Dry
18	Emery, Flattop-Sweetwater	25	26 S	13 E	5,472	Entrada	Elbert	Tide Water Assoc.				N F W, Dry
19	Grand, Hag Flat	11	26 S	19 E	8,389	Kayenta	Elbert	Tide Water Assoc.				N F W, Dry
20	Wayne, Teasdale	17	30 S	6 E	4,930	Sunbal	Leadville	Pac. West. Oil Corp.				N F W, Dry
21	Garfield, Upper Valley	12	36 S	1 E	8,857	Mesaverde	Hedwall	California Co.	191	(B)		NFW, Hedwall 8777'
		UINTAH MER.										
22	Wasatch, Strawberry Reservoir	33	4 S	11 W	2,758	Green River	Green River	Carter Oil Co.				N F W, Dry
23	Uintah, Roosevelt	21	1 S	1 E	9,391	Duchesne River	Green River	Carter Oil Co.	1633			NFW, Green R. 9360'
	WYOMING											
1	Carbon, South Baggs	15	12 N	92 W	3,940	Wasatch	Laramie	Phillips Pet. Co.		1	(NC)	N F W, Dry
2	Sweetwater, Canyon Creek	3	12 N	101 W	13,321	Wasatch	Morrison	Stanolind O & G Co.				NFW, Temp. Abd.
3	Laramie, Horse	13	13 N	68 W	11,374	Tertiary	Granite	California Co.	24			NFW, Muddy 8528'
4	Uinta, Sulphur Creek	15	13 N	119 W	4,325	Knight	Morrison ?	New Park Mng. Co.				D P T, Dry
5	Sweetwater, Salt Wells	11	14 N	103 W	7,215	Mesaverde	Nugget	Husky Fangely Co.		D		NFW, Dakota 6262'
6	Uinta, Leroy	32	16 N	117 W	6,201	Eocene	Madison	Shell Oil Co.				N F W, Dry
7	Laramie, Meadow	4	17 N	67 W	9,980	Tertiary	Dakota	Bridwell-Seaboard				N F W, Dry
8	Laramie, NE Horse Creek	7	17 N	67 W	5,753	Tertiary	Mesaverde	Carter & Beck				NFF W, Dry
9	Laramie, Horse Creek Sta.	36	17 N	70 W	2,905	Pierre	Dakota	Sharples Oil Corp.				N F W, Dry
10	Albany, James Lake	5	17 N	75 W	6,584	Qual.-Steele	Casper	California Co.				N F W, Dry
11	Laramie, Indian Hill	13	18 N	65 W	6,180	Qualiala	Pierre	Indian Basin O. Co.				N F W, Dry
12	Carbon, Hatfield	2	19 N	88 W	6,544	Steele	Deadwood	Ohio Oil Co.	342	(A)		D P T, Dry, P B
13	Lincoln, Mona	30	19 N	112 W	12,358	Bridger	Morrison	Union Oil Co.				N F W, Dry
14	Carbon, Hatfield	35	20 N	88 W	4,450	Steele	Nugget	Ohio Oil Co.	27		.8	SPT, Nugget 4320'
15	Albany, E. Rock River	20	21 N	76 W	3,602	Niobrara	Casper	Ohio Oil Co.				N F W, Dry
16	Carbon, Grenville	28	21 N	86 W	3,341	Carlile	Cambrian	Sinclair O & Gas Co.				N F W, Dry
17	Carbon, Foote Creek	26	22 N	78 W	2,642	Cloverly	Casper	California Co.				N F W, Dry
18	Sweetwater, Leucite Hills	30	22 N	103 W	8,255	Mesaverde	Nugget	Carter Oil Co.				N F W, Dry
19	Sweetwater, Nitchie Gulch	17	23 N	103 W	8,706	Mesaverde	Morrison	Amerada Pet. Corp.				N F W, Dry
20	Carbon, Table Hills	12	25 N	87 W	7,361	Steele	Tensleep	Westates Pet. Corp.				N F W, Dry
21	Carbon, Hog Sandy	7	26 N	86 W	4,364	Carlile	Tensleep	Rocky Mt. Gas Co.				N F W, Dry
22	Fremont, Whiskey Peak	33	27 N	91 W	13,228	Wasatch	Morrison	Brit. Amer. O.P. Co.				N F W, Dry
23	Sublette, Pacific Creek	27	27 N	103 W	20,521	Green River	Frontier	Superior Oil Co.				N F W, Dry
24	Sublette, No. La Barge	4	27 N	113 W	4,138	Green River	Hilliard	Gen. Pet. Corp.				N F W, Dry
25	Natrona, Lost Creek	22	29 N	80 W	5,222	White River	Madison	Tide Water Assoc.				N F W, Dry
26	Lincoln, Smith's Fork	16	30 N	118 W	7,630	Qual.-Thaynes	Amsden	Shell Oil Co.				N F W, Dry
27	Lincoln, Afton	9	30 N	119 W	7,233	Twin Creek	Ankareh	Continental Oil Co.				N F W, Dry
28	Lincoln, Afton	15	30 N	119 W	5,108	Twin Creek	Thaynes	Continental Oil Co.				N F W, Dry
29	Fremont, Derby Dome	4	31 N	98 W	3,189	Chugwater	Madison	Thermo Pet. Co.				D P T, Dry
30	Natrona, Poison Spring	31	32 N	83 W	13,130	Wind River	Frontier	Tide Water Assoc.				N F W, Dry
31	Fremont, Beaver Creek	10	33 N	96 W	10,403	Wind River	Amsden	Stanolind O & G Co.	681			DT, Tensleep 10442'
32	Sublette, Pinedale	17	33 N	109 W	7,797	Wasatch	Wasatch	Stanolind O & G Co.				N F W, Dry
33	Converse, Glenrock	32	34 N	75 W	7,259	Lance	Thermopolis	Steelco Drg. Co.	400			NFW, Muddy 7202'
34	Fremont, Gleasner	36	34 N	91 W	7,805	Cody	Tensleep	Southern Prod. Co.				N F W, Dry
35	Niobrara, Lightning Creek	36	35 N	66 W	3,991	Tertiary	Sundance	Atlantic Ref. Co.	238			NFW, Sundance 3870'
36	Niobrara, Bright	11	36 N	64 W	7,929	Fox Hills	Spearfish	Tide Water Assoc.				N F W, Dry
37	Niobrara, Little Buck Cr.	26	36 N	64 W	6,531	Pierre	Madison	Continental Oil Co.	360			DT, "Leo" 5746'
38	Natrona, Hell's Half Acre	32	36 N	85 W	6,318	Cody	Mowry	Ohio Oil Co.				N F W, Dry
39	Natrona, Sage Spring Cr.	30	37 N	77 W	9,539	Lance	Madison	Amerada Pet. Corp.	125			NFW, Dakota 7250'
40	Natrona, Arminto	19	37 N	86 W	3,539	Cody	Mowry	Husky Ref. Co.				N F W, Dry
41	Niobrara, Snyder Cr.	22	40 N	63 W	5,774	Lance	Lakota	Buck Creek Oil Co.				N F W, Dry
42	Weston, Alkali Cr.	15	41 N	63 W	5,530	Lance	Lakota	Atkinson-Delta				N F W, Dry
43	Johnson, Tisdale	21	41 N	81 W	4,016	Mowry	Pre-Cambrian	Tide Water Assoc.				N F W, Dry
44	Weston, Alkali Butte	4	42 N	64 W	6,236	Lance	Lakota	H. P. Hayes				N F W, Dry
45	Weston, Thunder Creek	8	42 N	66 W	4,385	Fort Union	Lakota	Brinkerhoff Drg. Co.				N F W, Dry
46	Johnson, Sussex	17	42 N	78 W	7,867	Lance	Morrison	Continental Oil Co.	280			SPT, Shannon 4530'
47	Johnson, Sussex	23	42 N	78 W	7,485	Lance	Morrison	Continental Oil Co.	264			NFW, Lakota 7455'
48	Johnson, No. Meadow Cr.	27	42 N	78 W	8,339	Lance	Sundance	Amer. Liberty O. Co.				N P W, Dry
49	Johnson, No. Meadow Cr.	35	42 N	78 W	4,513	Lance	Steele	Delhi Oil Corp.	460			NFW, Sussex 3923'
50	Weston, Blacktail Cr.	5	43 N	61 W	3,452	Pierre	Lakota	G. H. Parker				N F W, Dry
51	Weston, Wash Creek	6	43 N	63 W	4,913	Lance	Skull Creek	Texas Co.				N P W, Dry

(B) Well suspended as probably non-commercial.

IMPORTANT WILDCATS DRILLED IN 1949

LINE NUMBER	COUNTY AND LOCALITY	LOCATION SEC.	TWP.	RGE.	TOTAL DEPTH	FORMATION	DEEPEST HORIZON TESTED	DRILLED BY	INITIAL PRODUCTION PER DAY OIL, BBL.	GAS, MCF	CONDENSATE OR BBL.	REMARKS
52	Beaton, Mush Creek	1	43 N	64 W	4,985	Lance	Skull Creek	Gabe McCall				O P, Dry
53	Beaton, Mush Creek	3	43 N	64 W	5,299	Lance	Skull Creek	Ajax Oil Co.	60			IP, Newcastle 5263'
54	Beaton, Mush Creek	5	43 N	64 W	5,664	Lance	Skull Creek	W. E. Morton				O P, Dry
55	Hot Springs, Murphy Dome	6	43 N	91 W	5,210	Cody	Madison	Farmers Union, Cent. Exc.	210			NFW, Tensleep 4390'
56	Hot Springs, Lake Creek	14	43 N	92 W	3,796	Spory	Tensleep	Barnsdall Oil Co.	578			NFW, Tensleep 3507'
57	Hot Springs, Blue Springs	31	43 N	92 W	3,342	Spory	Madison	Deep Rock Oil Corp.				N F W, Dry
58	Hot Springs, Red Rose	12	43 N	96 W	2,545	Phosphoria	Pre-Cambrian	Seaboard Oil Co.				NFW, Dry, OWU
59	Beaton, Blacktail Cr.	10	44 N	61 W	2,865	Pierre	Fall River	Stone & Ogle				N F W, Dry
60	Beaton, Blacktail Cr.	22	44 N	61 W	2,768	Pierre	Fall River	M. M. Newell				N F W, Dry
61	Beaton, Skull Creek	10	44 N	61 W	2,970	Pierre	Skull Creek	H. S. Hulse				O P, Dry
62	Beaton, Skull Creek	1	44 N	62 W	2,911	Pierre	Skull Creek	Newell & Carter				O P, Dry
63	Beaton, Skull Creek	24	44 N	62 W	2,950	Pierre	Newcastle	O. H. Parker	271			OP, Newcastle 2933'
64	Beaton, Skull Creek	29	44 N	62 W	3,765	Pierre	Skull Creek	H. G. Ames				O P, Dry
65	Beaton, Mush Creek	31	44 N	63 W	5,209	Lance	Morrison	Yellowstone Drg.Co.				O P, Dry
66	Beaton, Mush Creek	32	44 N	63 W	5,008	Lance	Lakota	Yellowstone Drg.Co.				O P, Dry
67	Beaton, Mush Creek	33	44 N	63 W	4,686	Fox Hills	Fall River	Amerada Pet. Corp.				N F W, Dry
68	Beaton, W. of Mush Creek	5	44 N	64 W	5,381	Lance	Fall River	Simon & Sanderson				
69	Beaton, Mush Creek	24	44 n	64 W	4,786	Lance	Skull Creek	Ajax Oil Co.	30			OP, Newcastle 4996'
70	Beaton, Mush Creek	26	44 N	64 W	4,985	Lance	Skull Creek	Perl Smith	300			OP, Newcastle 4946'
71	Beaton, Lodgepole Cr.	9	44 N	66 W	6,737	Lance	Fall River	Bay Pet. Corp.	30 (C)			NFW, Fall R. 6721'
72	Beaton, Lodgepole Cr.	2	44 N	67 W	7,270	Fort Union	Fall River	M. E. Morton				N F W, Dry
73	Johnson, Smith's Cut	10	44 N	79 W	13,254	Wasatch	Lakota	Amerada Pet. Corp.				N F W, Dry
74	Hot Springs, Little Sand Draw	2	44 N	96 W	6,126	Cody	Tensleep	Seaboard-Husky	617			NFW, Tensleep 6055'
75	Hot Springs, Little Sand Draw	2	44 N	96 W	6,166	Cody	Tensleep	Husky Ref. Co.	319			SPT, Phosphoria 5940'
76	Teton, Spread Creek	25	44 N	113 W	7,581	Cretaceous	Sundance-Nowry	Stanolind O & G Co.				N F W, Dry
77	Beaton, N. of Mush Creek	19	45 N	62 W	3,412	Pierre	Skull Creek	H. J. Dittus				N F W, Dry
78	Beaton, N. of Mush Creek	30	45 N	62 W	3,455	Pierre	Skull Creek	M. M. Newell				O P, Dry
79	Beaton, Skull Creek	35	45 N	62 W	2,820	Pierre	Skull Creek	Black Hills Drg. Co.				O P, Dry
80	Beaton, N. of Mush Creek	19	45 N	63 W	4,265	Fox Hills	Skull Creek	M. M. Newell				N F W, Dry
81	Beaton, N. of Mush Creek	24	45 N	63 W	3,510	Pierre	Skull Creek	H. J. Dittus				N F W, Dry
82	Beaton, N. of Mush Creek	36	45 N	63 W	3,475	Pierre	Skull Creek	Carter Oil Co.				O P, Dry
83	Beaton, Fiddler Creek	5	45 N	64 W	5,005	Fox Hills	Morrison	Husky Ref. Co.				N F W, Dry
84	Beaton, Fiddler Creek	5	45 N	64 W	4,638	Lance	Skull Creek	Yorman Oil Co.				N F W, Dry
85	Beaton, NW of Mush Creek	15	45 N	64 W	4,730	Fox Hills	Fuson	Kingwood Oil Co.				N F W, Dry
86	Beaton, Lonetree Cr.	16	45 N	67 W	7,718	Fort Union	Morrison	Esperado Mng. Co.	90			NFW, Newcastle 7286'
87	Johnson, Piano Hill	18	45 N	80 W	12,611	Wasatch	Frontier	Amerada Pet. Corp.				N F W, Dry
88	Hot Springs, Golden Eagle	12	45 N	97 W	9,582	Fort Union	Tensleep?	Phillips Pet. Co.	475			IPT, Tensleep 9350'
89	Hot Springs, Skelton Dome	26	45 N	100 W	6,585	Wasatch	Madison	Continental Oil Co.				N F W, Dry
90	Beaton, Fiddler Creek	2	46 N	65 W	4,510	Fox Hills	Skull Creek	Trigood Oil Co.				O P, Dry
91	Beaton, Fiddler Creek	3	46 N	65 W	4,740	Lance	Newcastle	M. M. Newell				N P W, Dry
92	Beaton, Fiddler Creek	5	46 N	65 W	5,060	Lance	Fall River	Trigood Oil Co.				N P W, Dry
93	Beaton, Fiddler Creek	9	46 N	65 W	5,221	Lance	Fall River	Trigood Oil Co.				O P, Dry
94	Beaton, Fiddler Creek	12	46 N	65 W	4,603	Fox Hills	Skull Creek	S. S. Garfield	140			OP, Newcastle 4589'
95	Beaton, Fiddler Creek	18	46 N	65 W	5,670	Lance	Skull Creek	Sprecher Drg. Co.				O P, Dry
96	Beaton, Fiddler Creek	22	46 N	65 W	4,847	Lance	Skull Creek	Trigood Oil Co.	1,020			OP, Newcastle 4812'
97	Beaton, Fiddler Creek	29	46 N	65 W	5,245	Lance	Skull Creek	Far West Oil Co.	384			OP, Newcastle 5214'
98	Beaton, Fiddler Creek	31	46 N	65 W	5,928	Lance	Fall River	Frontier Ref. Co.				O P, Dry
99	Beaton, Fiddler Creek	25	46 N	66 W	5,717	Lance	Skull Creek	Mule Creek Oil Co.	2,600			IP, Newcastle 5684'
100	Beaton, Hay Creek	29	46 N	66 W	6,382	Fort Union	Skull Creek	Ajax Oil Co.				O P, Dry
101	Beaton, Hay Creek	33	46 N	66 W	6,446	Lance	Fall River	Schlumjer Bros.	45			NFW, Newcastle 6396'
102	Beaton, W. of Hay Creek	36	46 N	67 W	6,605	Fort Union	Skull Creek	Hulse & Carlson				O P, Dry
103	Washakie, Sand Creek	2	46 N	91 W	10,352	Wasatch	Madison	Gen. Pet. Corp.				N P W, Susp.
104	Washakie, South Fork	23	46 N	92 W	10,360	Wasatch	Phosphoria	Gen. Pet. Corp.	85			OF, Phosphoria 10395'
105	Beaton, N. of Fiddler Cr.	34	47 N	65 W	4,570	Lance	Skull Creek	Trigood Oil Co.				N P W, Dry
106	Washakie, South Frisby	24	47 N	93 W	10,665	Wasatch	Phosphoria	Gen. Pet. Corp.	42			NFW, Phos. 10580'
107	Park, Franks Fork	23	48 N	103 W	5,108	Quat.-Cody	Madison	Taylor Oil Co.				NFW, Dry (OWU)
108	Park, W. Fourbear	31	48 N	103 W	5,451	Wasatch	Madison	Wilshire Oil Co.				NFW, Dry
109	Crook, Moorcroft	18	49 N	67 W	5,832	Lance	Lakota	Amerada Pet. Corp.				NFW, Dry
110	Crook, Moorcroft	25	51 N	67 W	2,827	Cenerous	Minnelusa	Central States Drg. Co.				NFW, Dry
111	Campbell, East Aden	14	52 N	69 W	6,512	Lance	Sundance	Amerada Pet. Corp.				NFW, Dry
112	Big Horn, Greybull	21	52 N	93 W	3,340	Frontier	Madison	Oriental Ref. Co.				IPT, Dry
113	Crook, Oshoto	28	53 N	68 W	5,690	Lance	Fuson	Buffalo Drg. Co.				NFW, Dry
114	Campbell, Bertha	23	53 N	69 W	6,512	Lance	Spearfish	Amerada Pet. Corp.				NFW, Dry
115	Park, Shoshone	21	53 N	101 W	5,503	Cody	Madison	Husky Ref. Co.	148 (A)			IPt, Dry, IP
116	Crook, Stroner	21	55 N	68 W	5,500	Lance	Sundance	Trigood Oil Co.				NFW, Dry
117	Crook, Stroner	34	55 N	68 W	4,610	Fox Hills	Lakota	Texas Co.				NFW, Dry
118	Campbell, W. Stroner	22	55 N	69 W	5,430	Lance	Skull Creek	Wm. Hamm, Jr.				NFW, Dry
119	Park, Sand Coulee	8	55 N	100 W	13,447	Wasatch	Madison	Stanolind O & G Co.				NFW, Dry
120	Sheridan, Clear Creek	11	57 N	78 W	12,215	Wasatch	Cambrian	Shell Oil Co.				NFW, Dry
121	Big Horn, Sage Creek	10	57 N	97 W	3,822	Cody	Phosphoria	Western Oil Syn.				NFW, Dry
122	Crook, Lightning Flat	27	58 N	68 W	3,995	Pierre	Morrison	Amerada Pet. Corp.				NFW, Dry
123	Crook, Lightning Flat	35	58 N	68 W	3,450	Pierre	Newcastle	Amerada Pet. Corp.				NFW, Dry
124	Park, N. Badger Basin	23	58 N	102 W	10,287	Wasatch	Frontier	Stanolind O & G Co.				NFW, Dry
		WIND RIVER AREA										
125	Hot Springs, Brooks Dome	31	9 N	3 E	4,787	Frontier	Madison	Continental Oil Co.				NFW, Dry
126	Fremont, Little Dome	15	5 N	1 W	3,708	Thermopolis	Phosphoria	Pac. West. Oil Corp.				NFW, Dry
127	Fremont, NW Sheldon	36	6 N	3 W	5,169	Cody	Tensleep	Phillips Pet. Co.				NFW, Dry
128	Fremont, Riverton	25	1 S	4 E	11,884	Wind River	Tensleep	Atlantic Ref. Co.	312			NFW, Tensleep 11667'
129	Fremont, No. Alkali Butte	1	1 S	5 E	6,418	Wind River	Cody	Stanolind O & G Co				NFW, Dry

(C) Abd. in Jan. 1950.

FOOTNOTES FOR ENTIRE TABLE 2

Note: This list includes exploratory wells completed during 1949 below 2,500 feet, and successful wells of shallower depths.

ABBREVIATIONS USED

NFW - New Field Wildcat

NPW - New Pool Wildcat

OP - Outpost (1 mile or more from a previous producer)

SPT - Shallower Pool Test

DPT - Deeper Pool Test

OWDD - Old well drilled deeper

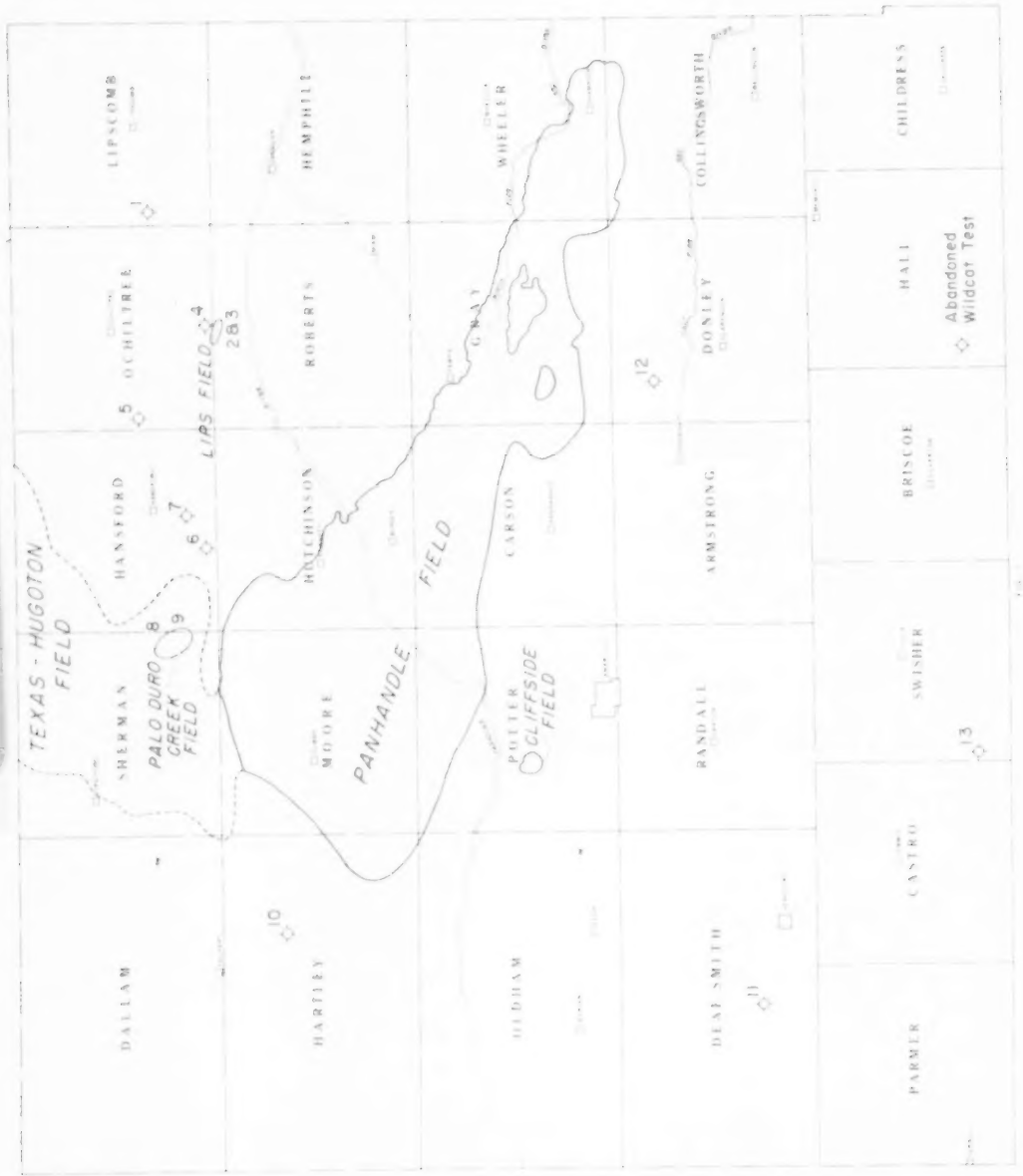
NC - Non-commercial

Name of newly discovered producing zone and top depth is given under remarks.

FIG. 1 - WYOMING STRATIGRAPHIC NOMENCLATURE CHART

	BIG HORN BASIN	WIND RIVER BASIN	POWDER RIVER BASIN WESTERN PORTION	POWDER RIVER BASIN EASTERN PORTION	JULESBURG BASIN	LARAMIE-HANNA BASIN	RAWLINS UPLIFT, GREAT DIVIDE, WASHAKE BASINS	ROCK SPRINGS UPLIFT, GREEN RIVER BASIN
POST-EOCENE		WHITE RIVER		WHITE RIVER	DAWSON ARKOSE / WHITE RIVER	NORTH PARK / WHITE RIVER	NORTH PARK	BROWNS PARK CONGLOMERATE / BISHOP CONGLOMERATE
EOCENE	WASATCH: TATMAN / WILLWOOD	TEPEE TRAIL / AYCROSS / WIND RIVER	WASATCH	WASATCH		WASATCH / HANNA	BRIDGER / GREEN RIVER / WASATCH	BRIDGER / GREEN RIVER / WASATCH: KNIGHT, FORKES, ALMY
PALEOCENE	FORT UNION	FORT UNION	FORT UNION	FORT UNION (Tongue Rv, Lebo, Tullock)		FERRIS	FERRIS	EVANSTON
UPPER CRETACEOUS	LANCE / MEETEETSE / MESAVERDE / COODY / FRONTIER / MOWRY / THERMOPOLIS: Muddy Ss	LANCE / LEWIS / MESAVERDE / COODY / FRONTIER / MOWRY / THERMOPOLIS: Muddy Ss	LANCE / FOX HILLS / LEWIS / MESAVERDE / STEELE (Brower Ss, Sharon Ss) / NIOBRARA / CARLILE / FRONTIER / MOWRY / THERMOPOLIS: Muddy Ss	LANCE / FOX HILLS / PIERRE / NIOBRARA / CARLILE / GREENHORN / BELLE FOURCHE / MOWRY / NEWCASTLE / SKULL CREEK / GRANEROS: Muddy Ss	LANCE / FOX HILLS (Laramie Ss) / PIERRE / NIOBRARA / CARLILE / GREENHORN / GRANEROS: Muddy Ss	MEDICINE BOW / LEWIS / MESAVERDE / STEELE / NIOBRARA / CARLILE / FRONTIER / MOWRY / THERMOPOLIS: Muddy Ss	LANCE / LEWIS / MESAVERDE / STEELE / NIOBRARA / CARLILE / FRONTIER / MOWRY / THERMOPOLIS: Muddy Ss	LANCE / LEWIS / ADAVILLE: ALMOND, ERICSON, ROCK SPRINGS, BLAIR / HILLIARD: BAXTER / FRONTIER / ASPEN / BEAR RIVER
LOWER CRETACEOUS	CLOVERLY: DAKOTA (GREYBULL) / FUSON / LAKOTA	CLOVERLY: DAKOTA / FUSON / LAKOTA	CLOVERLY: DAKOTA / FUSON / LAKOTA	DAKOTA (FALL RIVER) / FUSON / LAKOTA	CLOVERLY: DAKOTA / FUSON / LAKOTA	CLOVERLY: DAKOTA / FUSON / LAKOTA	DUNOIR: DAKOTA / FUSON / LAKOTA	DAKOTA / FUSON / LAKOTA
JURASSIC	MORRISON / SUNDANCE / GYPSUM SPRING	MORRISON / SUNDANCE / GYPSUM SPRING / NUGGET	MORRISON / SUNDANCE / GYPSUM SPRING	MORRISON / SUNDANCE / GYPSUM SPRING	MORRISON / SUNDANCE	MORRISON / SUNDANCE	MORRISON / SUNDANCE / NUGGET	BECKWITH OR GARRETT: MORRISON / CURTIS (STUMP) / ENTRADA (PREUSS) / TWIN CREEK OR CARMEL / NUGGET
TRIASSIC	CHUGWATER / DINWOODY	CHUGWATER / DINWOODY	CHUGWATER	SPEARFISH	CHUGWATER	JELM / CHUGWATER / DINWOODY	JELM / CHUGWATER / DINWOODY	CHUGWATER OR ANSAREH / MEMBER: THAYNES, WOODSIDE / DINWOODY
PERMIAN	EMBAR: PHOSPHORIA	EMBAR: PHOSPHORIA	PHOSPHORIA	MINNEKAHTA / OPECHE	MINNEKAHTA / OPECHE	FORELLE / SATANKA	PHOSPHORIA	PHOSPHORIA OR PARK CITY
PENNSYLVANIAN	TENSLEEP / AMSDEN	TENSLEEP / AMSDEN	TENSLEEP / AMSDEN	MINNELUSA	HARTVILLE	CASPER / FOUNTAIN	TENSLEEP / AMSDEN	WELLS OR: TENSLEEP OR WEBER / AMSDEN OR MORGAN
MISSISSIPPIAN	MADISON	MADISON	MADISON	MADISON (PAHASAPA)	MADISON (GUERNSEY)		MADISON	MADISON
DEVONIAN	THREEFORKS / JEFFERSON	DARBY			DEVONIAN UNDIVIDED			THREEFORKS / JEFFERSON / ORDOVICIAN UNDIFFERENTIATED
ORDOVICIAN	BIGHORN	BIGHORN	BIGHORN	BIGHORN			CAMBRIAN UNDIFFERENTIATED	
CAMBRIAN	GALLATIN / GROS VENTRE / FLATHEAD	GALLATIN / GROS VENTRE / FLATHEAD	DEADWOOD	DEADWOOD		DEADWOOD		CAMBRIAN UNDIFFERENTIATED
PRE-CAMBRIAN	METAMORPHIC & IGNEOUS ROCKS	METAMORPHIC & IGNEOUS ROCKS	METAMORPHIC & IGNEOUS ROCKS	METAMORPHIC & IGNEOUS ROCKS	METAMORPHIC & IGNEOUS ROCKS	METAMORPHIC & IGNEOUS ROCKS	METAMORPHIC & IGNEOUS ROCKS	METAMORPHIC & IGNEOUS ROCKS

Compiled by Wyo. Geol. Assoc. Nomenclature Committee - March - 1951


LIPSCOMB
HEMPHILL
WHEELER
COLLINGSWORTH
CHILDRESS
OCHILTREE
ROBERTS
GRAY
DONLEY
HALL
Abandoned Wildcat Test
HANSFORD
HUTCHINSON
CARSON
ARMSTRONG
BRISCOE
SHERMAN
MOORE
POTTER
RANDALL
SWISHER
DALLAM
HARTLEY
OLDHAM
DEAF SMITH
CASTRO
PARMER
TEXAS - HUGOTON FIELD
PALO DURO CREEK FIELD
LIPS FIELD
283
PANHANDLE FIELD
CLIFFSIDE FIELD
4
5
6
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8
9
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13

Oil And Gas Developments In Texas Panhandle Area During 1949

By J. F. DOUGHERTY, * Member AIME

(The Texas-Hugoton Field is reported with Hugoton Field)

Both field development and exploration activities increased over the year 1948, with greatly increased "wildcat" drilling in the counties north and south of the Texas Panhandle Field proper.

OIL

During the year 1949, 527 oil wells were completed in the Panhandle Field and one oil well was completed in the new Lips Field, Roberts County and one oil well in the new Palo Duro Creek Field, Sherman County. The oil development in the Panhandle Field consisted primarily of extensions of the Dial-Stinnett trend and infill drilling in Carson, Gray and Hutchinson Counties.

The Panhandle Field produced 33,016,852 bbl of oil, the largest annual volume since 1944. The cumulative oil production as of January 1, 1950, was 660,205,000 bbl.

GAS

During the year 1949, 131 gas wells were completed in the Panhandle Field, a temporary increased development rate resulting from the proration of the sweet gas area. One gas well was completed in each of the new fields discovered in the area during 1949, proving up two new lower Pennsylvanian gas reservoirs.

The metered gas production in the Panhandle Field totaled 833,210 MMcf and the net volume of gas produced, including estimated gas wasted less gas injected, totaled 849,233 Mmcf. The cumulative production of gas to January 1, 1950 is estimated to be 16,518,682 MMcf.

Natural Gasoline and Liquified Petroleum Gases - A total of 610,000,000 gal of natural gasoline and 167,600,000 gal of propane and butane were produced by 30 gasoline plants during 1949 from the processing of approximately 775 billion cu ft of gas.

Carbon Black - In 1949 376,000,000 pounds of channel black were produced from 229 billion cubic feet of gas, a weighted average recovery of 1.64 pounds of black per Mcf of gas consumed. Stocks of channel black increased from 13,471,000 pounds to 68,539,000 pounds during 1949.

Furnace black operations yielded 90,626,000 pounds of black from 10.3 billion cubic feet of gas, a weighted average recovery of 8.8 pounds of black per Mcf of gas consumed. Stocks of furnace black increased from 7,467,000 pounds to 10,201,000 pounds during 1949.

Exploration Activity - There were no major extensions of the productive limits of the Panhandle Field in 1949.

Exploratory efforts in 1949 culminated with the discovery of two new fields north of the Amarillo Arch. The Sinclair Oil and Gas Co. discovered the Lips Field, Roberts County, Texas by gravity and seismic work. Subcommercial oil production was found in the Upper Mississippian limestones at 8,900 ft and two Pennsylvanian gas reservoirs were proved on the same structure at depths of 5,350 ft and 8,028 ft.

The Phillips Petroleum Co. discovered the Palo Duro Creek Field in southern eastern Sherman County, Texas with the development of commercial gas production in the lower Pennsylvanian at 5,380 ft, and oil production at 5,900 ft. The structure was discovered by subsurface geology and seismic work.

Several "wildcat" tests drilled in 1949 and drilling in 1950 are apparently defining the limits of the new fields, particularly with respect to the oil producing horizons.

Interest in the south plains country, the counties south of the Panhandle Field, was intensified by the exploration for "reef" trends in the northern part of the West Texas counties. Leasing and geophysical work were active. The results of "wildcat" tests in this area were not encouraging, but the density of tests per county is still very low.

ACKNOWLEDGMENT

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BIBLIOGRAPHY

Dougherty, J. F., "Oil and Gas Development in Texas Panhandle in 1948," Statistics of Oil and Gas Development and Production, 1949, A.I.M.E.

Horn, Paul H., "Developments in Texas Panhandle in 1949," Bull. Amer. Assoc. Petrol. Geol., Vol. 34, No. 6 (June, 1950).

* GEOL., PET. ENGR., DEGOLYER & MACNAUGHTON, 1000 CONTINENTAL BLDG., DALLAS, TEXAS.

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TABLE I - OIL AND GAS PRODUCTION STATISTICS FOR TEXAS PANHANDLE AREA IN 1949

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION				CONDENSATE PRODUCTION (Thousands of Bbl.)	
				AREA PROVED ACRES	THOUSANDS OF BBL. TO END OF 1949	THOUSANDS OF BBL. DURING 1949	AREA PROVED ACRES	MILLION CU. FT.[c] TO END OF 1949	MILLION CU. FT.[c] DURING 1949		TO END OF 1949	DURING 1949
1	Lipa, Roberts	Douglas Sand, Pen Atoka Sand, Pen (?) Mississ., Mis	1949	0 0 320	0 0 3,634	0 0 3,634	2,000 3,100					
2	Palo Duro Creek, Sherman	Kathryn Sand, Pen Willcio Lime, Pen	1949	0 40	3,634 0 0	3,634 0 0	10,000 0	0 0	0 0			
3	Panhandle, Carson		1921	21,610	70,314	4,121	247,200	x	157,524 x	D G C H		
4	Collingsworth		1926	0	0	0	24,160	x	845	D G		
5	Gray		1925	61,680	305,376	14,567	227,000	x	48,726 x	D G C H		
6	Hartley		1928	0	0	0	53,000	x	28,308	D G		
7	Hutchinson		1922	76,000	246,616	13,115	217,000	x	61,177 x	D G C H		
8	Moore *		1926	1,200	6,104	102	496,000	x	384,554	D G		
9	Potter		1919	10	74	0	145,000	x	43,032	D G		
10	Wheeler		1925	8,390	31,761	1,112	156,000	x	40,800 x	D G C H		
	Panhandle, Sub-totals								764,985 68,255 Estimated 11,959 Unmetered 11,621 Injected 7,557	D G C H		
	Totals, Panhandle			368,890	660,205	33,017	1,563,360	16,518,682	849,233			

* Pressure Base 14.65 psia
+ Does not include Moore County - Bugtoon Field gas production
D G Metered Gas from gas wells
C H Metered Gas from oil wells

LINE NUMBER	NUMBER OF WELLS[c]			WELLS PRODUCING[f] DEC. 1949			RESERVOIR PRESSURE LB. PER SQ. INCH		SECONDARY RECOVERY[g]	CHARACTER OF OIL[h]		PRODUCING FORMATION					DEEPEST ZONE TESTED[n] TO END OF 1949	
	COMPLETED TO END 1949	1949		OIL		GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT.[k]	PROD. THICKNESS AVG. FT. GROSS	STRUCTURE[m]	NAME	DEPTH OF HOLE, FT.
		COMPLETED	ABANDONED	FLOWING	ARTIFICIAL LIFT													
1	0	0	0		0	0	-	-				S	15	5,350	18	A	Osage, Miss	9,544
	1	1	0		0	1 SI	2,600	-				S	20	8,028	20			
	1	1	0		1	0	2,530			35		L o	x	8,900	40			
2	1	1	0		0	1 SI	-	-				L o	x	5,380	x			
	1	1	0		0	0	-	-		40		L s	x	5,900	x	A	Pre-Cam.	7,739
3	1,354	16 gas 71 oil	2		881	467	430	x		39	0.06	D	x	2,400	350	A f	Pre-Cam.	5,648
												L						
												G w						
												Pre-C.						
4	11	0	2		0	8	430	x				D	x	2,200	25-150	A	? Miss	5,988
												G w						
5	3,402	25 gas 102 oil	16		2,756	301	430	x	√	39	0.04	D	x	2,700	100-300	A f	Penn	4,408
												E						
												G w						
6	51	0	2		0	50	430	x				D	x	3,000	250	A	Pre-Cam.	5,059
7	4,306	12 gas 345 oil	8		3,041	357	430	x		35	0.08	D	x	2,500	50-900	A	Ellenburger, Ord	7,682
												L						
												G w						
8	802	51 gas 4 oil	2		25	771	430	x		31	0.08	D	x	2,800	200-1000	A	Ellenburger, Ord	8,012
												L						
												G x						
9	93	31 gas	0		0	80	430	x		x	x	D	x	2,000	50-1000	A f	Pre-Cam.	6,161
												L						
												G w						
												Pre-C.						
10	925	7 gas 5 oil	3		422	339	430	x		37	x	D	x	1,700	25-300	A f	? Penn.	8,514
												L						
												G w						
	11,144	131 gas 527 oil 658	35		7,125	2,373	430	c 242										

IMPORTANT WILDCATS DRILLED IN 1949

LINE NUMBER	COUNTY	LOCATION SEC. SURVEY	LOCATION BLK. LAT.	LOCATION SUR. LONG.	TOTAL DEPTH, FT. OR METERS	FORMATION	DEEPEST HORIZON TESTED	DRILLED BY	INITIAL PRODUCTION PER DAY OIL, U.S. BBL.	INITIAL PRODUCTION PER DAY GAS, MILLIONS CU. FT.	INITIAL PRODUCTION PER DAY CONDENSATE U.S. BBL.	CHOKE, FRACTIONS OF AN INCH	PRESSURE, LB. PER SQ. IN. CASING	PRESSURE, LB. PER SQ. IN. TUBING	REMARKS
1	Lipscomb	413	43	H&TC	14,278	Tertiary	Arbuckle, Ord	Gulf Oil							P & A
2	Roberts	35	C	G&M	9,557	Tertiary	Osage, Mis	Sinclair O & G	420			3/4"	895	150	G O R 1,595
3	Roberts	157	13	TE&NO	9,137	Tertiary	Meramec, Mis	Sinclair O & G		41.0				2,041	
4	Ochiltree	142	13	TE&NO	11,200	Tertiary	Mis	Gulf Oil							P & A
5	Ochiltree	12	4-T	TE&NO	10,640	Tertiary	Arbuckle, Ord	Gulf Oil							P & A
6	Hansford	5	4	PSL	9,214	Tertiary	Arbuckle, Ord	Gulf Oil							P & A
7	Hansford	7	3	SA&M	8,665	Tertiary	Arbuckle, Ord	Gulf Oil							P & A
8	Sherman	15	3-T	TE&NO	6,464	Tertiary	Meramec, Mis	Phillips Pet	225						
9	Sherman	8	3-B	G&RH	7,739	Tertiary	Pre-Camb	Phillips Pet		19.3					
10	Hartley	148	48	H&TC	7,853	Tertiary	Arbuckle, Ord	Pure Oil							P & A
11	Deaf Smith			Rambo	10,191	Tertiary	Pre-Camb	Honolulu Oil							P & A
12	Donley	5	C-4	GCSF	5,265	Tertiary	Pre-Camb	Humble O & R							P & A
13	Swisher	9	O D	Dan-widdie	9,658	Tertiary	Pre-Camb	Humble O & R							P & A

	IN PROVEN FIELDS	WILDCATS
Number of wells located or drilling Dec. 31, 1949	135	13
Number of oil wells completed during 1949	527	2
Number of gas wells completed during 1949	131	2
Number of dry holes completed during 1949	35	22

Oil And Gas Developments In Hugoton Area During 1949

By J. F. DOUGHERTY *, Member AIME

GENERAL

Activity in the Hugoton Field of Kansas, Oklahoma and Texas reached a new high in 1949 with the completion of 639 new gas wells, a 20 per cent increase in completions over 1948.

PIPELINE ACTIVITY

A new major pipeline from the Hugoton area was placed in operation by the Michigan-Wisconsin Pipeline Co. from Sherman and Hansford Counties, Texas, to markets in Michigan and Wisconsin. Initial delivery capacity is approximately 320 MMcf per day, with major increases proposed for 1950.

The Plains Natural Gas Co. acreage in Texas County, Oklahoma, and Stevens and Seward Counties, Kansas, was placed under long term contract by the Northern Natural Gas Co.

* GEOL., PET. ENGR., DEGOLYER & MACNAUGHTON, 1000 CONTINENTAL BLDG., DALLAS, TEXAS.

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EXPLORATION ACTIVITY

There were no major extensions of the proved productive limits in the Permian producing section of the Hugoton gas field in 1949.

The exploratory efforts of 1948 culminated in 1949 with the development of two one-well fields along the borders of the Kansas-Hugoton Field. In Morton County, Kansas, the Stanolind Oil and Gas Co. No. 1 Bear well, producing gas and condensate from the basal Pennsylvanian at 5,000 ft was designated the discovery well of the Richfield Field. The Stanolind Oil and Gas Co. No. 1 Wheatley in Seward County has been designated the discovery well of the Kismet Field, producing oil from the Marmaton group at 5,100 ft.

In the southern part of the Hugoton area, in Hansford County, Texas, the Phillips Petroleum Co. discovered both oil and gas production in the Pennsylvanian section below 5,000 ft. Although within the limits of the Hugoton Field, these new discoveries are discussed with the Oil and Gas Developments in the Texas Panhandle, as they have no particular bearing upon the development and production from the Permian gas reservoir.

TABLE 1 - GAS PRODUCTION IN HUGOTON FIELD, KANSAS, OKLAHOMA AND TEXAS

LINE NUMBER	STATE, COUNTY	PRODUCING FORMATION NAME AND AGE	YEAR OF DISCOVERY	AREA PROVED, ACRES	METERED ** GAS PRODUCTION MILLION CU. FT. TO END OF 1949	METERED ** GAS PRODUCTION MILLION CU. FT. DURING 1949	COMPLETED TO END 1949	NUMBER OF WELLS COMPLETED	NUMBER OF WELLS PRODUCING +	RESERV PRESS PSIA WELLHEAD	RESERV PRESS PSIA AVG BHP	CHARACTER	POROSITY PERCENT	DEPTH TO TOP PROD ZONE FT	PROD THICK	DEEPEST ZONE TESTED TO END OF 1949 STRUCTURE	DEEPEST ZONE TESTED TO END OF 1949 NAME	DEEPEST ZONE TESTED TO END OF 1949 DEPTH FT
1	Kansas																	
2	Finney		1936	245,700	31,753	11,833	152	72	129							Arbuckle, Ord		5,484
3	Grant		1910	373,400	198,244	43,792	425	84	384							Penn U		2,903
4	Hamilton		1946	38,000	0	0	5	1	0							Arbuckle, Ord		6,556
5	Haskell		1936	272,200	72,647	30,082	302	41	200							Penn L		2,918
6	Kearney		1936	363,200	98,305	39,045	280	69	228							Pre-Cam		6,071
7	Morton		1930	147,200	72,435	6,332	92	5	83							Arbuckle, Ord		6,561
8	Seward		1922	177,000	18,748	7,549	96	44	67							Arbuckle, Ord		7,340
9	Stanton		1944	140,400	7,121	6,843	135	9	121							Penn		3,005
10	Stevens		1927	465,900	654,134	95,529	620	79	498							Arbuckle, Ord		7,140
		Herington, Per Krider, Per Winfield, Per Ft. Riley, Per										D L LS OL						
11	Total Kansas			2,233,100	1,151,804	222,022	2,004	404	1,823	440	x		6-18	2200-2600	15-100	M.C.		
12	Oklahoma																	
13	Texas	Herington, Per Krider, Per Winfield, Per Ft. Riley, Per	1922	915,000	548,597	105,093	802	81	756			D L LS OL						
14	Total Oklahoma			915,000	548,597	105,093	802	81	756	440			6-30	2500-2800	15-100	M.C.	Ord	5,898
15	Texas																	
16	Hansford	Herington, Per Krider, Per Winfield, Per	1938	165,400	30,655	9,614	117	13	92			D L LS OL	6-18	2800-3000	15-100	M.C.	Arbuckle, Ord	9,214
17	Moore	Herington, Per Krider, Per Winfield, Per Ft. Riley, Per	1945	34,000	4,522	4,056	25	12	25			D L LS OL	6-18	1000-1300	15-150	M.C.	Penn	3,556
18	Sherman	Herington, Per Krider, Per Winfield, Per Ft. Riley, Per Penn U	1939	465,000	121,745	51,005	398	159	253			D L LS OL	6-18 F	2500-3200	15-200	A.M. M.C.	Ellenb., Ord Pre-Cam	4,000+ 7,779
19	Total Texas			654,400	396,946	68,675	538	154	371	440	x							
20	Total Hugoton Fld.			3,782,600	1,896,945	395,790	3,344	639	2,974									

* Includes wells completed but shut in for lack of pipeline connection
\+ Includes only wells connected to pipelines
** Pressure Base 15.6 psia

Oil And Gas Developments In Pacific Coast Area During 1949

By L. E. PORTER * and L. W. CHASTEEN **, Members, AIME

INTRODUCTION

The Pacific Coast area, consisting of Arizona, California, Nevada, Oregon, and Washington, has experienced a phenomenal development subsequent to the discovery of gold at Sutter's Mill in 1848. Such development has not been one of change, but rather attributable to the vast occurrence and blessings of the area's many natural resources. Though gold initiated this spectacular growth, the discovery of commercial quantities of petroleum within California--some 16 years afterward--marked the birth of another great natural resource industry, destined to supply about 90 per cent of the current energy requirements of the Pacific Coast area--a section of the nation comprising 18.5 per cent of its land and having over 10 per cent of its peoples. Since there is no other major supply of fuel, the power supplied by the area's petroleum has made possible the growth and expansion of other essential industries.

CALIFORNIA PRODUCTION

This state, up to the present, has been the sole source of the Pacific Coast's domestic petroleum supply. Further, the importance of oil to the economy of this region is partially reflected by the fact that the accumulative value of California's past petroleum production is now over $9.6 billion, or 4.2 times greater than that of its gold to the same date. Petroleum production and refined products accounted for 83 per cent of the state's combined mineral output of $1.1 billion in 1948, the latest year for which complete data are available.

The year 1949 confirmed the trend of oversupply begun in 1948, particularly in heavy crudes; this condition resulted in an addition of 18 per cent to petroleum stocks during the year. From a peak production of 949,900 B/D of crude oil in March, the voluntary program of shutting in or pinching back production some 130,000 B/D caused a reduction in rate to about 867,957 B/D by the year's end--the lowest since 1946. The daily average production rate for the year was 912,170, or 2.1 per cent below 1948, the peak year. Currently, California produces about 18 per cent of the nation's crude; at the end of 1949, its accumulative crude production amounted to 8.3 billion bbl, or 21.3 per cent of the United States total.

In terms of total bbl, California produced 332,942,156 bbl during 1949, compared to 340,074,480 bbl during 1948. The monthly production and producing wells are shown in the following tabulation:

TABLE I CALIFORNIA OIL PRODUCTION AND PRODUCING WELLS 1949

MONTH	PRODUCTION		NUMBER PRODUCING WELLS
	TOTAL BBL	B/D	
January	29,172,728	941,056	26,190
February	26,536,255	947723	26,278
March	29,446,872	949899	26,497
April	28,276,608	942,554	26,444
May	28,748,682	927,377	25,656
June	27,626,954	920,899	25,228
July	28,121,437	907,143	24,896
August	27,799,790	896,767	24,605
September	26,968,047	898,935	24,479
October	27,187,960	877,031	24,410
November	26,150,166	871,672	24,454
December	26,906,657	867,957	24,341
Total	332,942,156		

The above tabulation shows the effect of the cutback of production during the year. The cutback is more than indicated above due to the new development in the light oil fields. The best estimates show that the state was shut in 130,000 B/D at the end of 1949. This is 15 per cent of the state total production of December 1949.

The Conservation Committee of California Oil Producers continued its plan of classifying the fields and pools between scheduled and unscheduled. The scheduled classifications include those fields in which it is believed that conservation will be realized by restricting the production of oil or gas. For fields or pools in this classification, the Conservation Committee regularly issues schedules of recommended rates of production. In December 1949, there were 146 pools in the scheduled class whose estimated Maximum Efficient Rate, or MER, was 493,460 B/D. The estimated production of unscheduled pools was 393,694 B/D. When adjustments were made for new well completions and certain MER not available for production, the recommended rate for December 1949 was 900,400 B/D. The actual production for the month was 868,025 B/D.

During 1949 the ten largest oil fields produced 47 per cent of the state total. Comparing the 1949 ten largest fields with the ten largest in 1948 shows that two fields have replaced fields listed in the 1948 report. The new fields are the Cuyama and the McKittrick Groups. Of the two, Cuyama is the more spectacular because it is in a new California geologic province and was not produced before 1948. McKittrick, on the other hand, is an old area which has been stimulated by discoveries and extensions. The production and producing wells of the ten largest fields are shown in the following tabulation:

* MANAGER, ECONOMICS-STAT. DEPT., RICHFIELD OIL CORP., LOS ANGELES, CALIFORNIA.
** PETROLEUM ENGINEER, UNION OIL CO. OF CALIF., LOS ANGELES, CALIFORNIA.
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TABLE II PRODUCTION OF TEN LARGEST FIELDS IN 1949 CALIFORNIA

ORDER OF MAGNITUDE	FIELD	1949 PROD. M BBL	NO. OF PROD. WELLS
1	Wilmington	43,509	1,922
2	Ventura Avenue	21,040	671
3	Huntington Beach	21,035	1,188
4	Coalinga Nose	17,022	121
5	Buena Vista	13,907	913
6	Midway Sunset	12,757	2,431
7	Kettleman No. Dome	11,379	317
8	Long Beach	8,349	1,128
9	Cuyama Group	8,066	185
10	McKittrick Group	6,509	417
Total		163,983	9,293
State Total		340,074	24,341

DEVELOPMENT

During 1949, 1,723 new wells were completed in 89 fields; their combined initial "scheduled" production rate was approximately 237,000 B/D. The well completion rate reached a peak in May with 184 new wells; subsequently, the rate declined to an average of 122 wells per month by the end of the year. The Placerita Field led with 228 new wells, followed by the fields of Cuyama Valley and the Wilmington Field for second and third place, respectively. By the end of the year, the number of active drilling wells had declined some two-thirds from the January activity, thus showing a definite restriction in development activity which is confirmed by the reduction of new well notices in December to about one-half that of December, the previous year. A comparison of drilling activity for the period 1940 through 1949 is shown in the following tabulation:

TABLE III

YEAR	DRILLING NOTICES FILED	DRILLING WELLS ABD.	PRODUCERS ABANDONED	NO. OF PRODUCERS COMPLETED
1940	1,042	156	330	890
1941	1,215	179	286	941
1942	822	243	326	569
1943	1,693	256	262	1,163
1944	2,279	315	268	1,717
1945	2,132	390	338	1,707
1946	1,812	344	379	1,342
1947	2,094	452	266	1,580
1948	2,759	544	273	2,134
1949	2,455	671	217	1,723

DISCOVERIES AND RESERVES

During 1949 a record of 588 exploratory wells were drilled for a combined footage of 2,138,500 ft. Twelve new fields and pools of consequence were discovered during the year, the most important of which occurred at South Cuyama, Guijarral Hills, Russell Ranch, Padre Canyon, and Placerita. According to the American Petroleum Institute's annual reserve report, 166 million bbl were added to the state's proved crude reserves through the new field and pool discoveries. The estimates for California are summarized below:

ESTIMATED CRUDE AND CONDENSATE RESERVES — CALIFORNIA

	(1,000's bbl)
As of 1-1-49:	3,763,583
1949 Discoveries	166,195
Revisions, Extensions	225,915
Total	4,155,693
Less: 1949 Production	332,942
As of 1-1-50	3,822,751
Net Change	59,168
California's per cent U. S. Reserves	15.5%

California's most important discovery in the last decade occurred in 1949. This was Richfield Oil Company's discovery of the South Cuyama Field. The discovery well, Human #81-35 in Section 35-10N-27, was completed on May 4, 1949 for an estimated rate of 4,888 B/D and the settled initial production was 604 B/D. By December 1949, 61 wells had been drilled and the production averaged 9,422 B/D from the field. An important feature of the discovery was that it revived an interest in exploration in California and demonstrated that further discoveries are highly probable. The most spectacular development in 1949 was the drilling up of the Placerita Oil Field. Placerita Oil Field was originally discovered in 1920 and produced small amounts annually until 1949. In January 1949, Ramon Somovia initiated a new development in a northward extension of the field by bringing in Juanita #1. This well was completed for an initial production of 340 B/D of 22.4° gravity crude. By September 1949, the pool which is known as the Juanita Area, reached an estimated peak of 34,000 B/D and by December had declined to 25,318 bbl. Most of the production came from an 80 acre town lot area where 182 wells had been drilled in the eight-month period. This extensive drilling program was possible because California's well spacing act was nullified by the Superior Court as a result of litigation in the Placerita Oil Field.

In all, 16 new fields and pools were discovered as a result of 1949 exploration activity. A list of the discoveries, as reported in the Annual Review of the Conservation Committee, is shown on page 376.

EXPLORATORY ACTIVITY OTHER PACIFIC COAST STATES

In Washington, exploration was much less intensive in 1949 than the previous year, the most important taking place in Grays Harbor and Kitsap Counties. At Grays Harbor County, the Union Oil Company of California drilled its State #3 to a depth of 9,344 ft. Tests of showings from intervals 3,670 to 4,400 and 4,663 to 4,676 ft yielded small quantities of light oil and a little gas. In Oregon, one wildcat well was abandoned at a depth of 6,480 ft in metamorphic rocks. In Arizona, several wells were drilled in the Winslow-Holbrook area in the northeasterly portion of the state; so far as known, the results were disappointing. Leasing and exploratory work in Nevada was greater than that state had ever experienced previously. Major and independent companies leased up many thousands of Federal and private acres. A number of geologic parties have been active in the eastern part of the state and it is reported that some exploratory wells will be drilled in the near future.

NEW FIELDS AND NEW POOLS IN OLD FIELDS DISCOVERED DURING 1949 IN CALIFORNIA

COUNTY	FIELD OR POOL	NEW FIELD OR POOL	DATE OF DISCOVERY	COMPANY AND WELL	PRODUCING FORMATION	TOTAL DEPTH, FT.
Santa Barbara	Russell Ranch	New Pool	2-7-49	Richfield Oil Corp. F. R. Anderson #18	Colgrove Sand (Lower Miocene)	3,642
Kern	Greeley "12-21"	New Pool	2-25-49	Standard Oil Co. KCL-12 #21	Jewett (?) (Lower Miocene)	13,578
Los Angeles	Placerita Canyon Juanita Area	New Area	3-3-49	J. Ramon Somovia Juanita #1	Kraft Zone (Pliocene)	1,831
Ventura	Padre Canyon West Area	New Pool	3-3-49	C. C. M. O. Hobson "B-100"	Lower Sta. Paula (Pliocene)	10,917
Fresno	Guijarral Hills Allison	New Pool	4-28-49	Barnsdall Oil Co. Allison #73	Lower Temblor (Miocene)	8,671
Santa Barbara	Cuyama South Homan	New Field New Pool	5-4-49	Richfield Oil Corp. Homan #81-35	Dibblee Sand (Lower Miocene)	4,392
Kern	Calder Stevens	New Field New Pool	5-4-49 KCL-Calder #38	General Petroleum	Stevens (Upper Miocene)	(12,733) 8,835 Redr.
Kern	Belgian Anticline Rankin	New Pool	5-24-49	Pacific Western Oil Rankin #86	(Lower Miocene	4,962 4,480 Plug
Kern	Salt Creek South Area Phacoides	New Pool	6-4-49	Carneros Oil Co. Anderson Comm. #3	Phacoides (Lower Miocene)	2,523 2,455 Plug
Ventura	Lion Mountain Eocene	New Pool	6-16-49	Humble Oil & Refg. Theo. E. Hammond #1	(Eocene)	4,350 4,048 Plug
Kern	Wasco Eocene	New Pool	9-9-49 (Old well deepened)	Standard Oil Co. Mushrush #5	Kreyenhagan (Eocene)	15,868 15,535 Plug
San Luis Obispo	Russell Ranch Norris Area Griggs-Dibblee	New Pool	10-11-49	F. C. Griggs & Assoc. Norris-Cuyama #3	Dibblee Sand (Lower Miocene)	4,115 3,420 Plug
Ventura	San Miguelito Grubb III	New Pool	11-8-49	Continental Oil Co. Gruff #75	(Pliocene)	9,210
Kern	Tejon Ranch Western Area Reserve	New Pool	11-11-49	Drilling & Prod. Co. J. V. #101	Reserve Sand (Miocene)	4,699

PETROLEUM SUPPLY AND DEMAND

The Pacific Coast situation in 1949, as reflected in trends from Bureau of Mines reports, shows the demand for the year averaged 958,000 B/D, a decrease of 1.46 per cent from 1948 average of 972,000 B/D. The year's supply averaged 1,010,000 B/D, or less than 1 per cent variation with the previous year. This condition resulted in an addition to petroleum stocks of about 19 million barrels.

The demand for gasoline for the year proved to be about the same as for 1948, thus confining the decreases to fuel oils. The heavy fuel oil situation was improved in the fall and winter, through fortunate resumption of shipment of residual fuels to the East Coast. By the year's end, such shipments amounted to about seven million barrels. It is to be noted these heavy shipments show promise of continuing well into 1950.

A comparison of the stocks of the principal products held in the Pacific Coast Territory (District V) for years ending 1948 and 1949 is shown opposite.

TOTAL STOCKS IN PACIFIC COAST TERRITORY
(Thousands of Bbl)

PRODUCT	12/31/49	12/31/48	CHANGE
Crude Petroleum	38,027	33,627	+ 4,400
Condensate	23	77	- 54
Natural Gasoline	821	681	+ 140
Liquefied Petroleum Gases	277	283	- 6
Gasoline & Napthas	20,775	14,739	+ 6,036
Kerosene & Kerosene Distillates	1,279	1,095	+ 184
Lubricating Oils & Distillates	2,545	2,486	+ 59
Stove Oil & Diesel Oil	14,558	10,746	+ 3,812
Fuel Oil	34,453	25,176	+ 9,277
Asphalt & Road Oils	1,113	962	+ 151
Coke & Other Finished Products	762	763	- 1
Cracking Stock	10,122	15,664	- 5,542
Other Unfinished Oils	571	596	- 25
Total	125,326	106,895	+18,431

SUMMATION

The year 1949 for the Pacific Coast petroleum industry proved to be one of ample supply and lessening demand for the heavy fuels and a leveling off of the motor fuel. The consolidation of expansion of industrial activity from the "peak" post-war years was to have been expected, and the resultant influence upon the oil industry cannot be overlooked. The shutting in of heavy oil, the decrease in drilling activity, the proposed changes in refining, and any continued East Coast demand for heavy California fuels should all lend considerable stability to the Coast's petroleum situation.

ACKNOWLEDGMENTS

No worthwhile compilations of statistics on the California oil producing industry could be made today without the utilization of the data from the Conservation Committee. The authors wish to express appreciation to W. R. Wardner, Jr. for his permission to use the statistical material from the Annual Review of California Crude Oil Production prepared under his direction for the Conservation Committee of California Oil Producers. To John Riegle, Jr. the authors express their appreciation for his help in the preparation of the gas production data.

TABLE I - OIL AND GAS DEVELOPMENTS IN CALIFORNIA DURING 1949

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl	
				AREA PROVED ACRES	BARRELS TO END OF 1949	BARRELS DURING 1949	AREA PROVED ACRES	MILLION[c] CU FT TO END OF 1949	MILLION[c] CU FT DURING 1949		TO END OF 1949	DURING 1949
1	SAN JOAQUIN VALLEY REGION											
2	Ant Hill, *Kern*	Oligene-Jewett, Mio		340	1,973,056	315,023			13			
3	Oligene		1944	x	1,569,302	274,098						
4	Jewett		1944	x	403,854	40,925						
5	Antelope Hills, *Kern*	Mio-Eoc		280	4,143,839	418,461		2,845	220			
6	East Block		1943	x	1,542,566	153,028		216	26			
7	West Block		1942	x	2,877,429	256,571		2,624	194			
8	Eocene		1942	x	23,844	8,862		5				
9	Belridge North, *Kern*	Pli-Mio-Olig		2,470	58,782,315	1,236,888		392,441	18,310			
10	Shallow		1912	x	4,804,875	13,676		11,167	18			
11	Temblor		1930	x	17,680,230	2,689		19,917	(5,628)			
12	'H' Sand		1939	x	540,619	146,379		15,273	5,616			
13	Belridge '64'		1932	x	34,189,679	868,762		343,706	18,284			
14	'Y' Sand		1942	x	1,566,912	205,382		2,378	20			
15	Belridge South, *Kern*	Plio-Mio	1911	7,680	45,959,162	1,682,814			351			
16	Buena Vista, *Kern*	Plio		15,000	377,907,305	13,907,215			8,305			
17	Buena Vista Front Area		1912	x	x	1,216,197						
18	Buena Vista Hills Area				x	12,691,018						
19	'27-H'	Plio	1944	4,360	57,962,015	9,938,689		24,440	3,884			
20	Others		1909	x	x	2,752,329			4,421			
21	Canal, *Kern*											
22	Stevens	Stevens-Mio	1937	1,010	14,575,682	693,826		15,488	947			
23	Coalinga Group, *Fresno*				642,589,737	33,266,450			38,584			
24	Coalinga Northeast, *Fresno*											
25	Eocene	Eocene	1939	1,500	31,246,132	2,312,542		75,398	17,960			
26	Coalinga Nose, *Fresno*											
27	Eocene	Eocene	1938	3,500	152,019,749	17,072,383		102,087	13,061			
28	Eastside, *Fresno*											
29	Temblor	Plio-Mio	1887	8,300	271,271,408	5,605,340		209,889	880			
30	Guijarral Hills, *Fresno*	Olig		1,100	2,996,306	2,907,271		1,936	1,879			
31	Allison		1949	x	367,402	367,402		259	259			
32	Leda		1948	x	2,628,904	2,539,869		1,677	1,620			
33	Jacalitos, *Fresno*	Mio		2,250	9,553,230	2,293,018		9,533	3,185			
34	Temblor Upper		1941	x	6,006,400	1,573,549		5,853	2,530			
35	Temblor Lower		1944	x	3,546,820	719,469		3,680	655			
36	Oil City, *Fresno*											
37	Cretaceous	Cretaceous		250	2,425,973	28,002			4			
38	Pleasant Valley, *Fresno*											
39	Eocene	Eocene	1943	570	7,774,130	1,151,779		7,089	1,425			
40	Westside, *Fresno*											
41	Temblor	Plio-Mio	1901	11,300	165,302,819	1,896,195			190			
42	Coles Levee North, *Kern*	Stevens-Mio		3,740	49,275,326	6,235,768		(1,992)	(1,814)			
43	Northwest Area											
44	Stevens		1939	x	264,805	21,625			14			
45	Richfield Western Area				48,960,521	6,214,143		(2,167)	(1,838)			
46	'21-I'		1940	x	4,379,606	543,410		4,208	(394)			
47	Western - '20'		1940	x	3,833,521	473,577		908	353			
48	Coles Levee North											
49	Richfield Western Area											
50	Main Western		1938	x	40,695,482	5,158,238		(7,338)	(1,815)			
51	'68-29'		1947	x	81,912	30,918		55	28			
52	Coles Levee South, *Kern*	Stevens-Mio		3,835	9,257,353	1,003,405			2,070			
53	Stevens F-1			x				(9,834)				
54	(Condensate)											
55	(Black Oil)		1939		8,329,440	927,122		5,458	(271)			
56	Stevens F-2			x								
57	(Condensate)							30,399	2,072			
58	(Black Oil)		1940		927,893	76,283		1,732	269			
59	Guyana Group				8,907,389	8,065,516		3,622	2,212			
60	Guyana South							440	440			
61	Himan		1949	3,200	1,188,195	1,188,195		440	440			
62	Russell Ranch, *Sta. Barbara & San Luis Obispo*	Mio		1,130				3,180	1,771			
63	Main Area											
64	Dibblee		1948	x	6,793,683	5,980,049		2,909	1,839			
65	Edgrove North		1949	x	330,526	330,526		123	(177)			
66	Edgrove South		1949	x	593,269	593,269		148	109			
67	Norris Area							2	1			
68	Norris		1948	x	13,395	5,156		1				
69	Griggs-Dibblee		1949	x	8,321	8,321		1	1			
70	Edison, *Kern*	Pli-Mio-Jur (?)		3,435	31,066,742	4,126,106			400			
71	Main Area				25,569,642	2,620,721						
72	First Uaff		1934	x	9,123,802	345,881						
73	Lamme-Bennet		1948	x	46,639	46,639			52			
74	Second Uaff		1934	x	4,149,938	112,436						
75	Fractured Schist		1945	x	12,249,273	2,115,765		447	143			
76	Portal-Fairfax Area											
77	Wicker		1944	x	662,894	87,129						
78	West Area											
79	Second Uaff		1947	x	4,853,714	1,417,764			205			
80	Miscellaneous Area											
81	Chanac		1949	x	492	492						
82	Elk Hills, *Kern*	Pli- Mio		19,850	202,139,504	3,056,800		152,947	(382)			
83	Main Area				202,137,698	3,056,800			(382)			
84	Upper		1920	x	200,650,177	1,984,191			(1,225)			
85	Lower (Stevens)		1941	x	1,487,521	1,072,609		1,162	843			

LINE NUMBER	NUMBER OF WELLS[c]			WELLS PRODUCING[f] DEC. 1949			RESERVOIR PRESSURE LB. PER SQ. INCH		SECONDARY RECOVERY[g]	CHARACTER OF OIL[h]		PRODUCING FORMATION					DEEPEST ZONE TESTED[n] TO END OF 1949	
	COMPLETED DURING 1949	FLOWING	ARTIFICIAL LIFT	SHUT IN	TOTAL	GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT.[k]	PROD. THICKNESS AVG. FT. / NET	STRUCTURE[m]	NAME	DEPTH OF HOLE, FT.
1																		
2			31	1	32					13.0-39.0	x	S	x	2,180	45	M F	Schist	
3			18	1	25													
4			7		7													
5			26	6	32					17.0	0.56	S	30	2,200	85	A F	Eocene	
6			8		8													
7			18	4	22													
8				2	2													
9	3	44	20	69	133					31.0-44.0	0.6	S	20	4,917	625	A F	Cretaceous	
10	3	1		12	13													
11		1		16	17													
12		6	2	2	10													
13		32	16	37	85													
14		4	2	2	8													
15	88		330	437	757					15.0-20.0	1.6	S-Sh	x	800	50	A C	Oligocene	
16	11	68	845	99	1,012					27.0	1.0	S	25	2,665	50	A	Miocene	
17	1		154	5	159													
18	10	68	691	94	853													
19		67	43	74	184					29.5	0.9	S	27	4,000	45	A C	(See Buena Vista)	
20	10	1	648	20	669													
21																		
22		14	16	9	39					37.5	0.7	S	22	7,975	225	A	Miocene	
23	112	201	1,262	511	1,974													
24																		
25		13	24	26	63					26.9	0.6	S	23	7,980	130	M U	Cretaceous	
26																		
27	1	108	13	36	157					29.8	0.6	S	20	6,400	360	M U	Eocene	
28																		
29	19		530	283	813					22.0	0.7	S	25	1,860	170	M P	Cretaceous	
30	56	60			60					37.8	x	S	x	8,645	80	M U	Oligocene	
31	17	17			17													
32	39	43			43													
33	10	14	95	4	113					38.0	0.8	S	x	3,865	150	A F	Cretaceous	
34	8	13	69	3	85													
35	2	1	26	1	28													
36																		
37			12	1	13					35.5	x	S	x	x	x	x	x	
38																		
39	1	6	16	3	25					28.8	0.6	S	14	8,940	200	A G	Eocene	
40																		
41	25		572	158	730					15.3	0.9	S	x	900-1,750	180	M P	Cretaceous	
42	9	108	5	15	128					36.0	0.8	S	20	8,000	320	A M	Miocene	
43																		
44		1			1													
45	9	107	5	15	127													
46	1	14	2	7	23													
47	3	13		4	17													
48																		
49																		
50	5	79	3	4	86													
51		1			1													
52	1	29	8	5	41					34.0-51.0	0.7	S	20	8,300	300	A M	Miocene	
53																		
54																		
55	1	24	8	5	37													
56																		
57																		
58		4			4													
59	147	151	34	3	188													
60	60																	
61	60	52	9		61													
62	85	99	25	3	127					35.0	0.3	S	28	2,800	100	M F-A F	Miocene	
63																		
64	64	81	19	2	102													
65	5	6	3		9													
66	16	11	2		13													
67	2																	
68	1		1	1	2													
69	1	1			1													
70	50	4	308	37	349					18.5	0.8	S-Sh	x	1,900	125	M U	Franciscan (Jur)	
71	8	3	172	34	209													
72			61	8	69													
73	6		9		9													
74			16		16													
75	2	3	86	26	115													
76																		
77			29	1	30													
78																		
79	42	1	105	2	108													
80																		
81			2		2													
82	44	27	163	446	636					22.0-36.0	0.9	S-Sh	38-30 ?	2600-5200	75-400	A F	Stevens-Mio	
83	44																	
84	4		161	409	570													
85	40	27	2	37	66													

TABLE I – CONTINUED OIL AND GAS DEVELOPMENTS IN CALIFORNIA DURING 1949

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO[c] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl	
				AREA PROVED ACRES	BARRELS TO END OF 1949	BARRELS DURING 1949	AREA PROVED ACRES	MILLION CU FT[c] TO END OF 1949	MILLION CU FT[c] DURING 1949		TO END OF 1949	DURING 1949
86	Northeast Area											
87	Olig		1944	x	1,806			240				
88	Fruitvale, *Kern*											
89	Martin-Kernco	Plio	1938	2,475	45,470,164	2,739,611			464			
90	Greeley, *Kern*	Mio		1,900	42,149,137	4,749,535		41,611	1,181			
91	Stevens		1936	x	4,759,084	184,905		15,382	191			
92	Rio Bravo - Vedder		1938	x	37,366,574	4,541,151		26,130	973			
93	'12-21'		1949	x	23,479	23,479		14	14			
94	Helm, *Fresno*	Mio-Eoc		4,100	7,327,443	979,063		21,986	4,023			
95	Miocene		1941	x	1,723,083	339,030		1,134	162			
96	Eocene		1942	x	5,604,360	640,033		20,852	3,861			
97	Kern Bluff, *Kern*	Mio	1944	500	1,334,581	838,634						
98	Kern Front, *Kern*	Plio	1925	4,100	71,261,512	2,534,867			299			
99	Kern River, *Kern*	Plio	1899	8,580	305,843,422	3,580,415			7			
100	Kettleman Middle Dome, *Kings*	Mio-Eoc			651,469	65,356						
101	Eocene		1936	80	117,358	65,356		1,141	649			
102	Temblor		1951	40	534,111							
103	Kettleman North Dome, *Fresno & Kings*	Mio-Eoc		16,630	361,892,685	11,739,352		2,036,740	72,800			
104	Temblor		1938	x	135,977,832	9,392,524		1,479,392	11,105			
105	Vaqueros		1938	x	14,640,332	1,555,591		28,922	4,846			
106	Eocene		1938	x	11,274,521	791,237		528,526	56,849			
107	Lanare, *Fresno*	Mio-Eoc		730	2,693,931	424,068		3,077	452			
108	Miocene		1943	x	2,228,243	359,539		2,729	393			
109	Eocene		1944	x	465,688	64,529		348	59			
110	Lost Hills, *Kern*	Plio		3,330	64,880,342	2,383,480			1,636			
111	Main Area		1910	x	62,433,353	2,299,699						
112	Williamson Area		1936	x	2,446,989	83,781						
113	McKittrick Group, *Kern*				132,439,397	6,508,676						
114	Belgian Anticline, *Kern*	Olig-Eoc			1,108,641	542,989		1,246	568			
115	Phacoides		1947	50	132,627	68,850		173	119			
116	Oceanic (Condensate)		1946	50	582,162	298,550		318	159			
117	Eocene		1947	60	386,663	168,400		742	277			
118	Haskin		1949	10	7,189	7,189		13	13			
119	Cymric, *Kern*	Plio-Mio-Olig-Eoc		1,400	19,995,464	3,258,586			8,321			
120	Shallow		1916	x	4,909,381	684,369			4			
121	Fitzgerald		1945	x	799,094	138,079		648	149			
122	Anderson		1945	x	558,480	59,195		498	60			
123	Weston		1945	x	384,915	56,235		429	61			
124	Weston 'D'		1945	x	254,231	29,159		96	16			
125	Bolton		1946	x	67,192	6,881		60	6			
126	Phacoides		1946	x	709,586	151,204		570	180			
127	Oceanic		1945	x	11,980,553	2,043,035		24,709	5,149			
128	Wasdy		1946	x	432,032	90,429		15,708	2,696			
129	McKittrick		1887	1,370	95,974,799	515,670			23			
130	McKittrick Front	Plio-Mio		500	6,712,340	351,439						
131	Upper			x	x	157,318						
132	Lower		1917	x	x	194,121			69			
133	Salt Creek, *Kern*	Plio-Mio		900	6,391,612	1,534,444						
134	Main Area				5,810,342	1,356,174						
135	Salt Creek		1946		7,065							
136	Carneros		1946		5,813,282	1,356,174		3,447	202			
137	North Area											
138	Carneros		1946		106,638	11,916		25	4			
139	Rose Area											
140	Carneros'		1947		438,066	139,793		200	87			
141	Salt Creek											
142	South Area											
143	Phacoides		1949		26,561	26,561		23	23			
144	Sheep Springs, *Kern*	Mio-Olig		250	1,591,711	276,241		1,913	292			
145	'54-21'		1945	x	443,610	147,236			85			
146	Carneros		1944	x	672,283	37,518		67				
147	Oceanic		1947	x	475,818	91,487		1,714	207			
148	Temblor Ranch, *Kern*	Mio	1900	70	664,830	29,307						
149	Midway-Sunset, *Kern*	Plio-Mio		33,700	748,782,347	12,757,489						
150	Midway East Area				x	4,584,349						
151	Shallow		1901	x	x	3,387,939						
152	Lakeview		1910	x	29,993,365	727,309						
153	Gibson		1936	x	2,280,267	95,776						
154	Maricopa Flat		1928	x	x	268,306						
155	Pacific		1947	x	418,606	101,269						
156	Pentland		1948	x	10,499	3,550						
157	Midway West Area				x	6,577,694						
158	Upper		1901	x	x	5,795,058						
159	Quality		1936	x	10,978,039	496,367						
160	Republic		1938	x	x	211,003						
161	Section '6'		1943	x	964,884	75,267			4,790			
162	Santiago Area	Plio-Mio		110	7,994,766	1,595,448						
163	Shallow		1945	x	2,346	294						
164	Leutholtz		1945	x	7,992,420	1,595,152		2,113	434			
165	Mount Poso Group, *Kern*	Mio			104,667,991	4,215,944						
166	Baker, *Kern*											
167	Vedder		1935	75	2,699,003	90,057						
168	Dimmick, *Kern*											
169	Vedder		1928	400	2,819,008	140,947						
170	Dorsey, *Kern*											

LINE NUMBER	NUMBER OF WELLS[e]			WELLS PRODUCING[f] DEC. 1949			RESERVOIR PRESSURE LB PER SQ INCH		SECONDARY RECOVERY[g]	CHARACTER OF OIL[h]		PRODUCING FORMATION					DEEPEST ZONE TESTED[n] TO END OF 1949	
	COMPLETED DURING 1949	FLOWING	ARTIFICIAL LIFT	SHUT IN	TOTAL	GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT[k]	PROD. THICKNESS AVG. FT[l] NET	STRUCTURE[m]	NAME	DEPTH OF HOLE, FT
86																		
87																		
88																		
89	22		198	19	217					20.9	0.9	S	x	3,000	88	M U	Schist - Slate	
90	1	70	22	7	99					36.0	0.8	S	20	11,430	290	A M	Granite	
91			11		11													
92		70	10	7	87													
93	1		1		1													
94		22	29	20	71					28.0-63.0	0.5	S	20	11,430	290	A M	Granite	
95		7			7													
96		15	29	20	64													
97	39		92	22	114					14.0	x	S	x	935	35	x	Vedder (Vho)	
98	1		526	110	636					14.4	0.9	S	35	1,700	80	M F	Granite	
99	54		1,962	695	2,657					13.8	1.05	S	35	400	130	M U	Granite	
100	1									36.0	x	S	x	7600-10919	200-x	A	Eocene	
101	1	2			2													
102																		
103	6	103	216	118	435					35.0-48.0	0.75	S	x	6300-10200	450	A	Cretaceous	
104	5	53	169	99	321													
105		17	45	10	72													
106	1	33		9	42													
107		11	14		25					37.0	x	S	21	6,675	26	AN F	Eocene (?)	
108		11	6		17													
109			8		8													
110	6	1	549	64	614					18.0-33.0	x	S	x	1,170	80	A	Eocene	
111	4	1	522	61	584													
112	2		27	3	30													
113	12	38	379	228	645					37.0	x	S	x	4,700	30	A F	Granite	
114	4	13	2		15													
115	1	3			3													
116		5			5													
117	1	5	1		6													
118	2		1		1													
119	5	15	160	37	212					11.0-52.0	1.0	S	20-28	1,375	145	MLF	(See McKittrick)	
120	5		117	23	140													
121			8	3	11													
122			4	1	5													
123			2	2	4													
124		1			1													
125				2	2													
126		2	2	1	5													
127		4	26	4	34													
128		8	1	1	10													
129			89	139	228													
130			42	23	65					11.0-17.0	1.5	S	x	800	350	AMLF	Eocene	
131			20	23	43													
132			22		22													
133	2	9	46	16	71					15.0-36.0	x	S	33	1,785	300	AML	(See McKittrick)	
134		8	40	15	63													
135																		
136		8	40	15	63													
137																		
138		1		1	1													
139																		
140			5		5													
141																		
142																		
143	2	1	1		2													
144		1	24	12	37					24.0	x	S	x	345	21	A M	(See McKittrick)	
145			18	9	27													
146			3	1	4													
147		1	3	2	6													
148	1		16	1	17					16.0	1.0	S	x	429	x	M F	(See McKittrick)	
149	73		2,431	606	3,037					14.0-26.0	1.0	S	30	1,950	65	MLF	Miocene	
150	61		823	79	902													
151	51		689	72	761													
152	4		48	2	50													
153	1		20		20													
154			55	4	59													
155			10		10													
156			1	1	1													
157	12		1,577	527	2,104													
158	11		1,489	521	2,010													
159			63	1	64													
160	1		19	5	24													
161			6		6					21.0	1.4	S	x	2,460	300	M F	Miocene	
162			31		31													
163			1		1													
164			30		30													
165	8		541	7	548					15.4	0.8	S	35	1,600	150	M F	Granite	
166																		
167			19	1	20													
168																		
169			59	1	60													
170																		

TABLE I – CONTINUED OIL AND GAS PRODUCTION STATISTICS IN CALIFORNIA DURING 1949

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION AREA PROVED ACRES	OIL PRODUCTION BARRELS TO END OF 1949	OIL PRODUCTION BARRELS DURING 1949	GAS PRODUCTION AREA PROVED ACRES	GAS PRODUCTION MILLION CU FT TO END OF 1949	GAS PRODUCTION MILLION CU FT DURING 1949	GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl TO END OF 1949	CONDENSATE PRODUCTION Thousands of Bbl DURING 1949
171	Vedder		1928	200	1,641,544	105,092						
172	Dyer Creek, *Kern*											
173	Vedder		1941	20	34,508	6,752						
174	Granite Canyon, *Kern*											
175	Vedder		1935	100	257,936	65,780						
176	Mount Poso, *Kern*											
177	Vedder		1923	1,700	89,114,318	3,226,640						
178	Mount Poso North, *Kern*											
179	Vedder		1937	325	7,579,539	401,929						
180	West Mount Poso, *Kern*				7,493							
181	Section "B"											
182	Vedder		1944	75	514,642	178,747						
183	Mountain View, *Kern*	Plio-Mio		2,700	51,609,472	1,199,079		58,229	1,192			
184	Arvin Area				3,468,870	232,611						
185	Lower Chanac-Sta. Margarita		1945		1,345,482	150,228						
186	Others		1937		2,123,388	82,383						
187	Mountain View											
188	Di Giorgio Area											
189	Schist		1946		51,866	24,174						
190	Earl Fruit Area				1,176,230	121,467						
191	Hood-Wharton		1936		1,133,102	108,532						
192	Lamont		1946		43,118	12,935						
193	Northwest Area											
194	Hood-Wharton		1934		13,683,328	263,242						
195	Southeast Area											
196	Hood-Wharton		1933		33,029,188	557,585			1,192			
197	Paloma, *Kern*	Mio		6,520	14,970,791	4,294,882		53,733	16,988			
198	Main Area											
199	Paloma											
200	(Condensate)		1939	x				13,774	1,467			
201	(Black Oil)		1942	x	14,918,034	4,254,972		35,593	14,740			
202	Symons Area											
203	Symons											
204	(Condensate)		1942	x				4,293	744			
205	Paloma											
206	(Black Oil)		1945	x	52,757	39,910		73	37			
207	Poso Creek Group, *Kern*	Mio		2,630	13,867,380	784,639			51			
208	Pruss, *Kern*		1937	x	278,372	37,453						
209	McVan, *Kern*		1932	x	445,887	35,512						
210	Premier, *Kern*		1929	x	12,526,309	566,514						
211	Premier East, *Kern*		1944	x	613,352	145,160						
212	Premier West, *Kern*		1946	x	3,660							
213	Race Track Hill, *Kern*	Mio		430	2,897,898	692,549		7,396	1,836			
214	Jewett		1944	x	706,118	125,368		2,345	438			
215	Pyramid Hill		1945	x	1,419,230	285,043		4,407	1,158			
216	Vedder		1946	x	772,560	282,238		638	305			
217	Freeman		1947	x					35			
218	Raisin City, *Fresno*	Mio-Eoc		1,435	7,226,055	1,356,024		8,998	670			
219	Miocene		1941	x	5,201,843	1,130,266		5,445	315			
220	Eocene		1943	x	2,024,212	225,758		3,553	355			
221	Rio Bravo, *Kern*											
222	Rio Bravo - Vedder	Mio	1937	2,030	51,557,815	4,228,804		45,592	1,876			
223	Riverdale, *Fresno*	Mio-Eoc		1,980	8,913,799	966,349		14,742	1,824			
224	Miocene		1941	x	5,369,749	546,971		9,158	1,184			
225	Eocene		1943	x	3,544,050	419,378		5,584	640			
226	Round Mountain Group, *Kern*	Mio		2,670	57,713,247	2,437,724			10			
227	Alma, *Kern*											
228	Vedder		1947	x	214,648	82,055						
229	Coffee Canyon, *Kern*											
230	Vedder		1927	x	13,365,168	292,690						
231	Pyramid, *Kern*											
232	Vedder		1937	x	3,492,009	221,172						
233	Round Mountain Group											
234	Round Mountain, *Kern*			2,700								
235	Main Area			x	32,501,979	1,255,718						
236	Jewett		1928	x	5,793,631	183,076						
237	Vedder		1927	x	26,708,348	1,072,642						
238	Northwest Area											
239	Vedder		1937	x	5,975,612	236,663						
240	Sharktooth, *Kern*											
241	Vedder		1943	300	2,164,031	349,426						
242	Strand, *Kern*	Mio	1939	300	4,982,079	233,808		3,638	145			
243	Stevens Upper		1939	x	2,712,760	137,873		2,032	62			
244	Stevens Lower		1939	x	2,269,319	95,935		1,508	49			
245	Tank Vapor							98	44			
246	Strand East, *Kern*											
247	Stevens	Mio	1942	220	1,265,827	165,543		1,981	108			
248	Tejon Ranch, *Kern*	Plio			3,983,731	861,158		2,425	327			
249	Central Area			425								
250	Chanac		1944	x	319,368	66,042						
251	Reserve		1935	x	277,253	42,571						
252	Eastern Area											
253	Chanac-Sta. Margarita		1943	340	494,905	80,669			327			
254	Western Area			600								
255	Chanac			x	2,891,286	670,958						
256	Reserve		1949	x	919	919						

LINE NUMBER	NUMBER OF WELLS[e]			WELLS PRODUCING[f] DEC. 1949			RESERVOIR PRESSURE LB PER SQ INCH		SECONDARY RECOVERY[g]	CHARACTER OF OIL[h]		PRODUCING FORMATION					DEEPEST ZONE TESTED[n] TO END OF 1949	
	COMPLETED DURING 1949	FLOWING	ARTIFICIAL LIFT	SHUT IN	TOTAL	GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT[k]	PROD. THICKNESS AVG. FT. / NET	STRUCTURE[m]	NAME	DEPTH OF HOLE, FT
171			34	2	36													
172																		
173	1		1		1													
174																		
175			16		16													
176																		
177			313	2	315													
178																		
179			80		80													
180																		
181																		
182	7		19	1	20													
183	7	3	157	16	176					26.0	0.9	S	x	6,080	70	M F	Oligocene - (Miocene)	
184		1	28		29													
185			19		19													
186		1	9		10													
187																		
188																		
189			1	2	3													
190	1	2	6		8													
191	1	2	5		7													
192			1		1													
193																		
194	1		54	1	55													
195																		
196	5		68	13	81													
197	9	63	5	4	72					32.0-52.0	0.2	S	20	10,140	300	A	Miocene	
198																		
199																		
200																		
201	9	62	5	4	71													
202																		
203																		
204																		
205																		
206		1			1													
207	2		169	24	193					13.7	0.8	S	x	2,000	35	M U	Basement	
208			15		15													
209	1		18	2	20													
210			120	22	142													
211	1		16		16													
212																		
213	1	19	17	2	38					40.0	x	S	33	4,727	30	M F	Francisco (?)	
214		5	7	2	14													
215	1	13	4		17													
216		1	6		7													
217																		
218	14	21	38	3	62					24.0	0.7	S	21	5,040	10	A	Cretaceous	
219	14	16	33	3	52													
220		5	5		10													
221																		
222		85	4	12	101					40.5	0.6	S	22	11,250	220	A	Schist-Jur (?)	
223		27	21	6	54					35.4	0.7	S	x	6,500	35	A U	Jurassic (?)	
224		18	4	5	27													
225		9	17	1	27													
226	4		346	20	366					14.0-21.0	0.8	S	34	1,600	66	M F	Granite	
227																		
228			10	1	11													
229																		
230			61		61													
231																		
232			53		53													
233																		
234			174	11	185													
235			131	10	141													
236			39	6	45													
237			92	4	96													
238																		
239			43	1	44													
240																		
241	4		48	8	56					35.0	0.8	S	34	8,320	115	A	Miocene	
242			14		14													
243			9		9													
244			5		5													
245																		
246										34.0	0.8	S	25	8,132	90	A	Miocene	
247		4	3		7					18.6	0.48	S	x	2,600	40	M U	Eocene	
248	5		83	8	91													
249																		
250	1		15	3	18													
251	1		4		4													
252																		
253			18		18													
254																		
255			45	5	50													
256			1		1													

TABLE I – CONTINUED OIL AND GAS PRODUCTION STATISTICS IN CALIFORNIA DURING 1949

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl	
				AREA PROVED ACRES	BARRELS TO END OF 1949	BARRELS DURING 1949	AREA PROVED ACRES	MILLION[c] CU FT TO END OF 1949	MILLION[c] CU FT DURING 1949		TO END OF 1949	DURING 1949
257	Ten Section, *Kern*	Mio		2,220	46,462,225	2,351,057		126,473	4,075			
258	Stevens		1956	x	46,201,489	2,167,189		126,124	7,720			
259	'55'		1947	x	260,736	183,868		349	255			
260	Tusco, *Kern*	Mio		375	4,736,118	54,419		1,758	107			
261	Vedder		1938	x	4,704,037	27,391		1,672	21			
262	Eocene		1949	x	27,028	27,028		86	86			
263	Shale		1937	x	5,053							
264	Wheeler Ridge, *Kern*				4,869,801	280,389			106			
265	Coal Oil Canyon	Pli	1948	130	365,061	305,685		60	42			
266	Main	Pli-Mio	1922	230	4,504,740	74,704			64			
267	Other Fields				4,907,238	1,436,296			1,062			
268	Bacon Hills, *Kern*	Oligmio-Olig										
269	Oligmio		1947	80	144,381	22,128		678	805			
270	Bellevue, *Kern*											
271	Stevens – Upper	Stevens-Mio	1944	100	790,924	88,842		479	63			
272	Blackwells Corner, *Kern*											
273	Temblor	Mio	1941	200	331,681	43,127			7			
274	Burrel, *Fresno*											
275	Miocene	Mio	1943	105	170,442	113,342		75	60			
276	Calder		1949	75	44,732	44,732		65	65			
277	Camfield Ranch, *Kern*											
278	Stevens	Stevens-Mio	1938	20	174,429	7,363			7			
279	Chico Martinez, *Kern*	Plio-Mio	1938	50	47,271	1,727						
280	Other Fields											
281	Ciervo, *San Benito*	Eoc	1948	20	2,797	1,547						
282	Comanche Point, *Kern*	Mio	1945	70	23,646	8,030						
283	Devil's Den, *Kern*	Mio-Olig	1910	200	179,411	44,251			7			
284	Gosford, *Kern*											
285	Stevens	Stevens-Mio	1944	80	118,976	12,903		110	3			
286	Gosford East, *Kern*											
287	Stevens	Stevens-Mio	1948	275	386,294	182,371		419	416			
288	Gould Hills, *Kern*			10	419							
289	Jasmin, *Kern*	Mio	1946	70	169,375	46,764						
290	McLung											
291	Stevens		1943	20	106,238	446		96				
292	McDonald Anticline, *Kern*	Mio-Olig		100	193,434	81,695						
293	Gould Sand			x	x	x						
294	Hatton Bed		1947	x	x	x		1				
295	Phacoides		1945	x	x	x						
296	Panoche Creek, *Fresno*	Cre	1941	30	10,915	1,644			43			
297	Pyramid Hills, *Kings*	Olig	1951	140	580,383	79,338			10			
298	Rosedale Ranch, *Kern*	Mio	1945	80	162,611	15,337		196	19			
299	San Emidio, *Kern*											
300	Miocene	Mio	1948	10	1,146	296						
301	Shafter		1941	10	54,647							
302	San Joaquin, *Fresno*											
303	Eocene	Eoc	1947	75	393,472	135,833		116	43			
304	Tejon Hills, *Kern*	Mio	1948	300	264,536	241,656			1			
305	Terra Bella			10	19,613							
306	Turk Anticline			10	3,649							
307	Union Avenue, *Kern*	Pli	1941	50	641,511	63,024			13			
308	Vallecitos											
309	Cretaceous		1944	10	350							
310	Unidentified							3,040,073				
311												
312	San Joaquin Valley Region Total				3,615,955,507	148,827,492		8,546,908	199,851			
313												
314	Condensate											
315	Coles Levee South			x	7,992,538	1,301,707						
316	Paloma			x	10,566,335	1,791,545						
317												
318	Coastal Region											
319	Santa Maria District				304,810,780	15,223,814			16,685			
320	Barham Ranch	Pli	1943	10	8,960							
321	Bradley Canyon											
322	Sisquoc-Monterey	Pli	1943	40	25,883							
323	Casmalia	Pli-Mio		1,450	16,119,876	274,611			175			
324	Sisquoc-Monterey		1917	x	16,033,950	264,152						
325	Arellanes		1946	x	85,926	10,459						
326	Cat Canyon East											
327	Sisquoc-Monterey	Pliocene	1908	375	4,719,882	105,169						
328	Cat Canyon West	Pli-Mio		2,925	41,342,028	5,070,065			1,215			
329	Pliocene		1908	x	20,209,140	672,279			322			
330	Los Flores		1938	x	21,132,885	4,397,786		3,013	893			
331	Four Deer											
332	All Pools	Miocene	1947	320	485,125	189,891		491	245			
333	Gato Ridge											
334	Tognazzini	Pli-Mio	1931	490	16,638,426	1,149,501			488			
335	Guadalupe	Pli	1948	90	23,339	15,710						
336	Lompoc											
337	Monterey (All Pools)	Pli-Mio	1903	2,720	17,123,430	202,799			11			
338	Olivera Canyon	Mio	1943	240	415,258	167,480						
339	Orcutt											
340	Monterey (All Pools)	Plio-Mio	1903	4,440	109,216,664	1,716,842			2,736			
341	Santa Maria Valley	Pli-Mio-Jur (?)	1936	7,470	97,047,568	5,467,118			11,795			

LINE NUMBER	NUMBER OF WELLS[c]			WELLS PRODUCING[d] DEC. 1949			RESERVOIR PRESSURE LB PER SQ INCH		SECONDARY RECOVERY[e]	CHARACTER OF OIL[a]		PRODUCING FORMATION					DEEPEST ZONE TESTED[n] TO END OF 1949	
	COMPLETED DURING 1949	FLOWING	ARTIFICIAL LIFT	SHUT IN	TOTAL	GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[f]	POROSITY PER CENT[f]	DEPTH TO TOP OF PRODUCING ZONE FT[g]	PROD. THICKNESS AVG. FT. NET	STRUCTURE[h]	NAME	DEPTH OF HOLE, FT
256	5	31	89	11	131					38.5	0.7	S	20	7,850	200	A	Miocene	
258		29	84	11	124													
259	5	2	5		7					35.0	0.55	S	18	13,100	45	A	Eocene	
260		1	3		4													
261			3		3													
262		1			1													
263																		
264	7		54		54					23.5	x	S	x	875	90	A	Miocene	
265			30		30					23.5	0.8	S	x	1,600	600	A	Eocene	
266			34		34													
267	64	21	152	30	193					39.0	x	S	x	7,847	30	A F	Eocene	
268																		
269		1	1	1	3													
270										35.0	x	S	x	6,570	40	M F	Vedder (Mio)	
271		2	1		3													
272																		
273			25	1	26					13.0	x	S-Sh	x	800	50	A C	Oligocene	
274										27.0	x	S	20	6,484	15	A C	Cretaceous	
275	6	1	6		7													
276	2	2		1	3													
277																		
278			1		1					27.0	1.1	S	x	7,900	90	A(?)	Miocene	
279			4		4					14.0	x	S	x	850	30	A	Miocene	
280																		
281		1			1					25.0	x	S	x	1,103	80	A	Eocene	
282	1		1	9	10					13.0	x	S	x	100	x	x	Miocene	
283	6		15	2	17					19.6	0.7	S-Sh	x	100-800	x	A	Eocene	
284																		
285			2		2					33.5	x	S	x	7,800	15	x	Miocene	
286																		
287	12	12	1		13					34.0	x	S	x	7,900	15	x	Miocene	
288																		
289			8	1	9					14.0	x	S	25	2,769	25	x	Vedder (Mio)	
290																		
291				1	1													
292			18		19					15.0	x	S	x	800	105	A	Eocene	
293																		
294																		
295										x	x	S	x	7,250	x	x	x	
296		1			1													
297	1		22		23					18.0	x	S	x	600	130	A M	Cretaceous	
298			2	2	4					22.5	x	S	30	4,600	52	A M	Vedder (Mio)	
299																		
300			1		1					28.0	x	S	x	1,419	62	M F	Miocene	
301																		
302																		
303			6		6					31.0	x	S	x	6,972	13	?	Cretaceous	
304	1	1	35		37					29.0	x	S	x	300	28	x	Miocene	
305																		
306																		
307			2	1	3					14.0	x	S	x	4200-9150	30	M F	Oligocene	
308																		
309																		
310																		
311																		
312	806	1,167	11,150	3,660	15,977													
313																		
314																		
315																		
316																		
317																		
318																		
319	55	3	893	232	1,128					x	x	x	x	2,697	x	x	Miocene	
320																		
321																		
322										6.0	3.0	S	x	3,750	170	H M	Miocene	
323	4		20	31	51					8.5	3.5	F-Sh	x	1,330	Fis	A	Loupe (Olig)	
324	4		18	31	49													
325			2		2													
326																		
327	2		3	21	24					8.5	6.0	S	x	2,900	400	A	Cretaceous	
328	20		137	46	183					14.0-22.0	6.0	F-Sh	x	x	Fis	A	Cretaceous	
329			26	34	60													
330	20		111	12	123													
331																		
332	3	1	11		12					35.0	x	S	x	x	x	x	x	
333																		
334			42	3	45					12.5	5.3	F-Sh	x	1,800	Fis	A F	Miocene	
335	3			6	6					12.0	x	S	x	2,650	26	M F	Miocene	
336																		
337			3	6	9					19.8	4.1	F-Sh	x	2,300	Fis	A	Eocene (?)	
338	1			9	9					12.0	x	F-Sh	x	1,509	x	x	x	
339																		
340	12		259	3	262					22.5	3.0	Sh	x	1,100	Fis	A	Miocene	
341	4	2	127	86	505					15.3	5.2	F-Sh	x	4,000	Fis	M U	Francascan (?)	

TABLE I – CONTINUED OIL AND GAS PRODUCTION STASTICS IN CALIFORNIA FOR 1949

LINE NUMBER	FIELD (County)[4]	PRODUCING FORMATION NAME AND AGE[5]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO[6] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl	
				AREA PROVED ACRES	BARRELS TO END OF 1949	BARRELS DURING 1949	AREA PROVED ACRES	MILLION CU FT[7] TO END OF 1949	MILLION CU FT[7] DURING 1949		TO END OF 1949	DURING 1949
342	Tinaquaic	Pli		60	16,717	6,993						
343	Zaca Creek											
344	Monterey	Miocene	1942	810	1,627,634	657,635						
345	Santa Barbara District				106,050,133	3,464,613		82,994	2,122			
346	Capitan	Mio-Olig-Eoc	1929	260	13,564,588	758,770		9,185	864			
347	Vaqueros			x	9,187,142	395,880		2,740	195			
348	Erburu			x	2,188,041	34,696		4,117	122			
349	Covarrubias			x	1,947,012	274,152		2,173	510			
350	Coldwater			x	242,393	54,042		137	37			
351	Coal Oil Point											
352	Vaqueros	Mio-Olig	1947		620			18				
353	Elwood	Mio-Olig	1927	630	85,676,899	2,680,916		73,791	1,258			
354	Vaqueros			x	82,726,929	2,558,531			882			
355	Seaje - Main			x	2,684,941	19,859			115			
356	Seaje - West			x	265,029	102,526		566	261			
357	Santa Barbara											
358	Vaqueros	Miocene	1934	140	3,639,147	17,984						
359	Summerland	Pli-Mio	1894	140	3,179,879	6,943						
360	Ventura District				433,128,004	25,575,075			50,068			
361	Montalvo West											
362	McGrath	Pliocene	1947	320	474,931	266,011		1,367	527			
363	Padre Canyon	Pli	1936	660	10,813,078	2,654,879			3,754			
364	Main Area			x	3,734,293	159,951			207			
365	Oak Grove Area			x	4,701,525	1,193,336		5,977	2,121			
366	West Area			x								
367	Others			x	2,327,932	1,252,364		2,418	1,354			
368	Hobson 'H'			x	49,328	49,328		42	42			
369	Tank Vapors								30			
370	Rincon	Pli	1927	630	24,880,660	1,263,540		27,896	1,225			
371	Hobson-Tomson-Miley			x	24,592,936	1,230,355			1,198			
372	Riley (G-9)			x	287,724	33,185			27			
373	San Miguelito	Pli		310	30,312,493	2,350,339		43,376	5,049			
374	Grubb '1'		1931	x	16,225,863	1,328,171		39,645	3,906			
375	Grubb '2'		1944	x	4,067,841	1,003,379		3,713	1,036			
376	Grubb '3'		1949	x	18,789	18,789		17	17			
377	Ventura Avenue	Pli	1916	2,425	376,646,842	21,040,306		1,081,308	39,513			
378	A-3, B-3		1945	x	23,735,043	574,108		74,817	2,290			
379	B-1, 2		1930	x	841,469	162,512		2,359	511			
380	B-4, 5 West		1934	x	7,113,715	1,524,956		8,586	2,630			
381	'C' Block			x	221,828,465	3,972,948		773,573	10,640			
382	C-1, 2 West		1933	x	2,618,220	538,725		3,907	532			
383	C-3 West		1933	x	11,878,886	621,052		46,115	2,643			
384	C-6 West		1942	x	612,404	108,752		636	104			
385	D-3		1934	x	4,939,897	414,263		9,955	1,055			
386	D-4		1932	x	1,059,399	66,031		1,776	107			
387	D-5, 6 East		1931	x	38,878,002	2,236,462		69,241	5,517			
388	D-5 West		1934	x	26,844,736	1,809,773		53,637	4,420			
389	D-6 West		1935	x	7,780,848	1,409,655		11,002	1,997			
390	D-7		1935	x	28,515,558	7,601,069		24,980	6,614			
391	Tank Vapor								453			
392	Santa Clara Valley North District				38,848,451	6,536,144			7,741			
393	Block Ranch				1,517							
394	Del Valle, *L. A.*	Pli-Mio	1940	590	17,903,275	3,382,904		38,281	6,702			
395	East Area				4,798,119	514,922		12,835	1,843			
396	Sherman		1941		2,218,846	112,743		2,806	180			
397	Del Valle		1940		1,727,193	210,067		5,063	819			
398	D.L. 4 - D.L. 5		1944		47,991	5,115		964	67			
399	Hering		1943		615,223	110,089		3,025	386			
400	Lincoln '15'		1947		188,866	76,908		977	391			
401	Ramona Area			450	6,107,856	2,048,367		5,062	2,122			
402	Black		1946		520,948	123,317		381	141			
403	Kern - Del Valle		1945		5,586,888	1,925,050		4,691	1,981			
404	West Area				6,997,300	719,615		20,226	2,709			
405	N.L.F. - '3-1'		1944		22,662	3,544		18	4			
406	Sepulveda		1942		739,114	43,420		3,564	498			
407	Vasquez '13'		1945		819,027	178,078		676	183			
408	Vasquez-Videgain		1941		5,382,046	473,638		15,520	1,812			
409	Vasquez '14'		1948		34,451	20,935		449	212			
410	Tank Vapor							158	28			
411	Ex-Mission (Group) (A) Ventura	Pli	1875	230	2,104,829	12,883			3			
412	Hanley Canyon, *L. A.*	Pli	1944	10	9,359							
413	Holser Canyon, *Ventura*	Mio	1942	10	62,895	7,533		41	3			
414	Hopper Canyon, *Ventura*	Mio-Olig	1887	150	1,561,126	54,508			17			
415	Modelo, *Ventura*	Mio	1948	50	368,532	1,977						
416	Nigger Canyon				10,000				770			
417	Oak Canyon, *L. A.*	Mio		340	4,251,716	624,762			47			
418	1-A		1941		137,740	22,256						
419	3-AB		1944		1,107,798	140,970		1,758	187			
420	Oak Canyon (Contd)											
421	4-AB		1945	x	287,522	44,374		224	31			
422	5-A		1941	x	2,382,305	312,657		2,480	381			
423	6-AB, 7 & 8 AB		1945	x	336,351	104,505		386	124			
424	Ojai Group, *Ventura*	Mio-Olig	1885		4,605,911	259,548			63			
425	Lion Mountain		1935	40	84,609	6,809			4			
426	Sasar Silverthread		1885		3,600,747	26,500			5			
427	Sulphur Mountain North		1948		x	130,953			53			

LINE NUMBER	NUMBER OF WELLS[e]			WELLS PRODUCING[f] DEC. 1949			RESERVOIR PRESSURE LB PER SQ INCH		SECONDARY RECOVERY[g]	CHARACTER OF OIL[h]		PRODUCING FORMATION					DEEPEST ZONE TESTED[n] TO END OF 1949	
	COMPLETED DURING 1949	FLOWING	ARTIFICIAL LIFT	SHUT IN	TOTAL	GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT[k]	PROD. THICKNESS AVG. FT.[l] NET	STRUCTURE[m]	NAME	DEPTH OF HOLE, FT
342			1	2	3					7.0	x	S	x	x	x	x	x	
343																		
344	6			19	19					8.0	x	F-Sh	x	4,600	400	A	Cretaceous	
345	9	7	144	13	164													
346		4	65	2	71					18.0-40.0	0.8	S	20	1,150	135	A F	Eocene	
347			36		36													
348			16	1	17													
349		3	13	1	17													
350		1			1													
351																		
352										28.5	x	S	x	10,030	25	x	Seque (Olig)	
353	8	3	68	8	79					34.0	0.5	S	25	2,800	330	A F	Eocene	
354	6		64	6	70													
355			4		4													
356		3		2	5													
357																		
358			7	1	8					16.6	0.5	S	x	2,000	400	M F	Seque (Olig)	
359	1		4	2	6					18.7	x	S	x	400	x	M F	Seque (Olig)	
360	88	325	585	92	1,002													
361																		
362	3	7	1		8					38.0-46.0	x	S	x	11,405	x	x	Repetto (Plio)	
363	12	37	31	5	73					29.0	0.5	S	x	4,800	750	A F	Pliocene	
364		1	15		16													
365	4	24	7		31													
366																		
367	?	12	8	5	25													
368	1		1		1													
369																		
370		2	104	4	110					30.0	1.7	S	x	2,500	140	A F	Miocene	
371		2	101	4	107													
372			3		3													
373	16	45	12	16	73					32.0	1.5	S	18	5,500	680	A F	Pliocene	
374	8	23	11	14	48													
375	7	21	1	2	24													
376	1	1			1													
377	57	234	437	67	738					30.0	1.6	S	18	3,400	4,000	A F	Pliocene	
378	2	2	31	10	43													
379	3	4	8	1	13													
380	7	24	2	2	28													
381	1	4	267	13	284													
382	6	8	4	1	13													
383		14	11	16	41													
384		1	1		2													
385	1	8	21	2	31													
386			6	1	7													
387	1	29	38	7	74													
388	7	53	16	7	76													
389	12	22	19	2	43													
390	17	65	13	5	83													
391																		
392	21	30	312	52	394													
393																		
394	18	18	128	9	155					33.0-40.0	1.5	S	28	6,037	107	A	Miocene	
395	1	11	9		20													
396			8		8													
397		5	1		6													
398		1			1													
399	1	4			4													
400		1			1													
401	17	1	98	5	104													
402			10		10													
403	17	1	88	5	94													
404		6	21	4	31													
405			1		1													
406		1	3	1	5													
407		2			2													
408		2	17	3	22													
409		1			1													
410										25.1	1.8	S	x	600	x	M	Pliocene	
411			23	3	26					14.0	x	S	x	3,900	100	A	Miocene	
412				1	1					24.0	x	S	x	4,150	x	A	Miocene	
413			1		1					27.0	x	S	x	400-1,500	29	A F	Miocene	
414			15		15					14.0-28.0	x	S	x	250	x	A	Miocene	
415			10	1	11													
416										22.0-33.0	1.0	S	22	2,365	80	A	Miocene	
417		11	10		21													
418			5		5													
419		1	2		3													
420																		
421		1	1		2													
422		9			9													
423			2		2					15.0-22.0	x	S	x	315	x	M F	Eocene	
424	2		70	36	106													
425	1		2		2													
426			50	11	61													
427				1	1													

TABLE I – CONTINUED OIL AND GAS PRODUCTION STATISTICS FOR CALIFORNIA IN 1949

LINE NUMBER	FIELD (COUNTY)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION AREA PROVED ACRES	OIL PRODUCTION BARRELS TO END OF 1949	OIL PRODUCTION BARRELS DURING 1949	GAS PRODUCTION AREA PROVED ACRES	GAS PRODUCTION MILLION CU FT[c] TO END OF 1949	GAS PRODUCTION MILLION CU FT[c] DURING 1949	GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl TO END OF 1949	CONDENSATE PRODUCTION Thousands of Bbl DURING 1949
428	Sulphur Mountain		1927		95,592	592						
429	Timber Canyon		1885		724,015	92,607			1			
430	Tip Top - Fresno Canyon		1918		100,948	2,087						
431	Seque Canyon (Group) *Ventura*[93]	Olig	1887	480	3,858,066	105,085			12			
432	Torrey sal, *Ventura*	Mio	1924	190	4,111,225	186,944			171			
433	Santa Clara Valley South Dist.				104,610,901	13,759,435			11,447			
434	Aliso Canyon, *L. A.*	Plio-Mio-Eoc		960	10,256,955	1,275,141			872			
435	Porter		1938		5,300,555	275,488		2,594	127			
436	Del Aliso		1947		210,021	121,789		101	63			
437	Sesnon		1940		4,687,706	872,380		6,438	680			
438	Faulted Sesnon		1944		46,306	5,484			2			
439	Eocene		1945		10,367							
440	Bardsdale, *Ventura*	Olig-Eoc	1891	225	3,274,309	597,974			1,032			
441	Elkins Area											
442	Seque-Eocene		1943		102,094	55,046						
443	Other Areas											
444	Seque-Eocene		1894		3,172,215	542,928						
445	Conejo, *Ventura*		1892	90	102,000							
446	Newhall (Group), *L. A.*[163]	Plio-Mio	1876	560	6,851,069	32,268			23			
447	Newhall-Potrero, *L. A.*	Mio		945	19,887,302	3,185,310		18,183	1,601			
448	'1-2-3'		1937		17,223,459	1,928,750		15,653	436			
449	5th		1946		1,405,203	915,886		1,215	763			
450	6th		1945		1,139,838	279,796		1,233	356			
451	7th		1948		109,636	52,135		69	33			
452	9th		1948		9,176	8,740		13	13			
453	Newhall-Tonmte, *L. A.*	Mio	1948	10	2,765	1,222		6	6			
454	Oat Mountain, *L. A.*											
455	Eocene	Eocene	1946	10	9,743							
456	Oxnard, *Ventura*											
457	Pliocene-Miocene	Miocene	1937	250	3,104,503	255,952			97			
458	Placerita Canyon			450	5,199,252	5,137,193			3,258			
459	Old Area		1920		664,413	622,354			39			
460	Juanita Area		1949		4,514,839	4,514,839		3,219	3,219			
461	Shaells Canyon, *Ventura*											
462	Seque-Eocene	Olig-Eocene	1911	930	13,854,154	311,703			751			
463	Sisar, *Ventura*											
464	Seque-Eocene	Eocene	1912	400	2,024,485	33,829			5			
465	South Mountain, *Ventura*											
466	Seque	Olig	1916	1,210	32,549,700	2,463,316			3,388			
467	Topo - Eureka, *Ventura*											
468	Miocene	Miocene	1882	80	956,103	2,042						
469	Torrey Canyon, *Ventura*											
470	Seque	Miocene-Olig	1896	130	5,693,445	198,337			96			
471	West Mountain, *Ventura*											
472	Seque	Oligocene	1946	350	847,116	265,148			316			
473	San Luis Obispo County Dist.				1,525,980	36,005			1			
474	Edna	Mio	1906	210	1,514,520	36,005			1			
475	Edna			x	1,355,323	33,623						
476	Oak Park		1935	x	126,152	2,382						
477	East Elberta Area		1943	x	33,045							
478	Havens				11,470							
479	Santa Clara County District				906,660	827						
480	Moody Gulch - Los Gatos	Mio	1865	60	122,901	827						
481	Sargent	Mio	1865	60	783,759							
482	Sonoma County District											
483	Petaluma	Pli	1948	10	3,474	1,186						
484	Salinas Valley District				600,219	480,332		21	10			
485	San Ardo Group											
486	Haggin	Mio	1948	10	316							
487	Los Lobos	Mio	1948	60	21,076	21,076						
488	San Ardo	Mio	1947	2,300	578,457	458,886		15	10			
489	Campbell		1948		556,575	451,214		15	10			
490	Lombardi		1947		21,882	7,672						
491	Monroe Swell		1949	10	370	370						
492	San Mateo County District											
493	Half Moon Bay	Pli	1886	80	41,330							
494	Unidentified							470,548				
495												
496	Coastal Region Total				990,525,942	65,077,431		1,793,364	88,074			
497												
498	Los Angeles Region											
499	Alondra, *L. A.*	Mio	1946	75	881,215	194,480		494	112			
500	Brea-Olinda, *Orange*	Plio-Mio		1,650	203,186,689	5,212,544		267,377	5,067			
501	Brea Area		1889		187,319,427	2,408,977			2,309			
502	Olinda Area		1897		x	1,728,186			1,294			
503	Tonner Area		1920		15,867,262	1,075,381		19,409	1,314			
504	Underground Storage-Olinda								150			
505	Coyote East, *Orange*	Plio-Mio		1,190	58,425,173	1,655,980			1,223			
506	Graham-Loftus-Huddle		1911		45,993,577	705,660						
507	Mathis		1927		7,525,918	552,194						
508	Stern		1927		4,905,678	398,126						
509	Coyote West, *Orange*			1,170	164,831,957	4,784,168		140,499	6,466			
510	Top - East	Plio-Mio	1946		x	136,542			58			
511	Main		1909		139,021,930	1,467,209			1,121			
512	'90'		1924		x	1,438,757			1,998			
513	Lower '90' East		1944		1,980,268	192,701		1,503	(58)			

LINE NUMBER	NUMBER OF WELLS[c]			WELLS PRODUCING[f] DEC. 1949			RESERVOIR PRESSURE LB PER SQ IN		SECONDARY RECOVERY[g]	CHARACTER OF OIL[h]		PRODUCING FORMATION					DEEPEST ZONE TESTED[n] TO END OF 1949	
	COMPLETED DURING 1949	FLOWING	ARTIFICIAL LIFT	SHUT IN	TOTAL	GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE, FT[k]	PROD. THICKNESS AVG. FT / NET	STRUCTURE[m]	NAME	DEPTH OF HOLE, FT
428	1			20	20													
429			14		14													
430			4	4	8					21.0	x	S	x	400	x	A S	Olig-Eocene	
431	1		34	2	36					23.5	0.7	S	x	2,000	300	A	Miocene	
432		1	21		22													
433	262	66	854	95	1,015					22.0	1.0	S	25	4,795	170	A F	Eocene	
434	8	25	20	21	66													
435	1	1	9	10	20													
436	2		4		4													
437	5	34	6	11	41													
438			1		1													
439										27.9	2.0	S	x	400	x	A F	Eocene	
440	5	1	73		74													
441																		
442			2		2													
443										x	x	x	x	x	x	x	x	
444	5	1	71		72													
445																		
446			21	4	25					14.0-21.0	x	S	x	1,300	x	M C	Eocene	
447	10	40	27	26	93					35.0	0.9	S	17	6,160	300	A F	Miocene	
448	3	27	16	25	68													
449	7	9	10		19													
450		3	1		4													
451				1	1													
452		1			1													
453																		
454										x	x	S	x	9,285	95	A F?	Eocene	
455																		
456										8.0	7.5	S	x	2,100	200	M U	Miocene	
457			4	3	7													
458	228		256	8	264													
459	48		74	8	82													
460	180		182		182													
461										31.5	1.5	S	x	2,100	640	A	Eocene	
462			129	14	143													
463										26.8	0.7	S	x	1,100	x	A	Eocene	
464			51	12	63													
465										23.5	3.1	S	x	2,200	950	A	Eocene	
466	11		192	6	198													
467										22.6	x	S	x	500	x	A	x	
468			8		8													
469										28.0	x	S	x	700	x	A F	Oligocene	
470			49	1	50													
471										22.5	x	S	x	3,600	300	A	Sespe (Olig)	
472			24		24													
473	3		16	6	22					14.0-22.0	x	S	30	2,000	100	S	Basement-Jur (?)	
474	3		16	6	22													
475	1		16	6	22													
476	2																	
477																		
478																		
479										22.0	x	S	x	600-2,000	x	M	Miocene	
480			2		2					17.0	x	S	x	900	300	A M	Franciscan-Jur (?)	
481																		
482										20.0	x	S	x	946	25	x	x	
483			1		1													
484	38		15	45	60													
485										11.0	x	S	x	1,139	30	A	Miocene	
486										11.0	x	Sh	x	2,611	125	A	Miocene	
487	2			3	3					8.0-12.5	x	S	x	2,050	70	A	Shast	
488	35		15	42	57													
489	34		15	35	50													
490	1			?	?													
491	1			1	1													
492										x	x	S	x	1500-2,400	200	M	Pliocene (?)	
493																		
494																		
495																		
496	476	431	2,822	536	3,789													
497																		
498										25.5	x	S-Gc	x	9,087	60	A F	Schist-Jur	
499		4			4					23.0	1.05	S	x	290	800	A F	Miocene	
500	19	3	375	63	441													
501	14		150	4	154													
502	4	3	225	12	240													
503	1			47	47													
504										23.0	1.80	S	x	2,450	150	A F	Miocene	
505	12	1	175	34	210													
506	4		102	24	126													
507	6	1	45	8	54													
508	2		28	2	30													
509	16	21	259	16	296					32.0	1.6	S	20	2,800	475	A D	Miocene	
510	1		?		?													
511	2		119	1	120													
512	10		79	1	80													
513	2	2	10	1	13													

TABLE I – CONTINUED OIL AND GAS PRODUCTION STATISTICS FOR CALIFORNIA IN 1949

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl	
				AREA PROVED ACRES	BARRELS TO END OF 1949	BARRELS DURING 1949	AREA PROVED ACRES	MILLION CU FT[c] TO END OF 1949	MILLION CU FT[c] DURING 1949		TO END OF 1949	DURING 1949
514	Coyote West											
515	"138"		1947	x	453,801	145,051		784	360			
516	Emery East		1931	x	10,315,497	902,598		16,598	2,931			
517	Emery West		1930	x	12,913,217	491,600		21,289	114			
518	McNally		1939	x	147,266	9,710			2			
519	Dominguez, L. A.	Plio-Mio		1,100	182,636,840	4,615,846		298,556	6,634			
520	Pliocene East Block				5,932,940	584,878			189			
521	3rd, 4th & Upper 5th			x	4,389,668	403,443			102			
522	Lower 5th & 6th		1941	x	1,543,272	181,435			87			
523	Pliocene West Block											
524	5th		1944	x	1,710,530	276,641		1,099	191			
525	Pliocene Other Blocks											
526	All		1923	x	139,110,442	2,382,620			632			
527	Miocene				35,882,928	1,371,707			5,622			
528	7th Central Block		1933	x	7,105,247	140,552		22,242	148			
529	8th Central Block		1936	x	9,525,329	248,276		28,289	210			
530	South Central Block		1938	x	4,264,236	111,624		8,709	64			
531	Southwest Block			x	758,456	27,085			3,731			
532	West Block		1937	x	12,603,622	812,949		25,680	1,273			
533	West Town Lot Block		1941	x	1,636,038	31,221			63			
534	Tank Vapor							395	133			
535	Dominguez East, L. A.	Plio-Mio	1946	20	32,641	6,744			12			
536	Dominguez Southeast											
537	5th & 7th		1948	60	160,110	120,662		162	124			
538	East Los Angeles, L. A.	Mio	1946	200	1,444,204	449,784		2,702	657			
539	Vail		1946	x								
540	U. P. "3"		1947	x								
541	U. P. "1"		1946	x								
542	El Segundo, L. A.	Mio-Jur	1935	600	12,139,968	127,113			57			
543	El Segundo North, L. A.	Mio-Jur	1946	30	143,347	35,739		39	13			
544	Huntington Beach, Orange	Plio-Mio		4,200	438,162,153	21,034,896		431,913	16,768			
545	South Area (On Shore)(New)				53,810,666	2,676,304			1,784			
546	Tar Zone & Main		1926	x	50,610,722	1,973,040			1,414			
547	A-"97"		1942	x	2,481,308	385,930		2,443	102			
548	A-"66"		1945	x	398,242	96,940		690	268			
549	Fruit Zone			x	320,394	320,394			436			
550	Main (Inc. in Tar Zone)		1926	x								
551	South Area (Off Shore)(New)				122,278,330	12,318,896			9,802			
552	Jones		1942	x	21,655,271	3,635,312		12,188	2,051			
553	Main		1926	x	100,623,059	8,683,584			7,751			
554	North Area (Old)				242,051,658	6,035,697			5,182			
555	Tar Holes		1920	x		886,507			842			
556	Ashton		1921	x		5,149,190			3,904			
557												
558	Talbert Area		1947		21,899	3,999		6				
559	Inglewood, L. A.	Plio-Mio		850	169,960,811	5,064,443		125,080	3,800			
560	Vickers-Machado		1924		131,338,954	3,415,186			1,494			
561	Inglewood											
562	Rindge		1925	x	17,213,553	513,677		15,148	559			
563	Rubel		1934	x	15,931,922	467,194		16,370	630			
564	Maynier		1932	x	907,855	418,676			900			
565	Sentous		1940	x	4,568,527	249,710		14,829	617			
566	Lawndale, L. A.	Plio-Mio		170	1,668,799	285,025		3,230	675			
567	Upper Pools		1928	x	1,138,632	8,214		2	1			
568	Johnson		1947	x	530,167	276,811		3,228	674			
569	Long Beach, L. A.	Plio-Mio		1,400	742,923,188	8,348,499		940,009	7,250			
570	Old Area				738,524,176	8,226,584						
571	Upper Pools		1921	x	736,844,398	7,808,957						
572	De Soto		1938	x	1,484,134	341,937						
573	De Soto - North Flank		1947	x	195,644	75,690						
574	Northeast Extension Area		1937	x	4,399,012	121,915						
575	Montebello, L. A.	Plio-Mio	1917	2,080	153,327,099	2,346,024		166,982	2,803			
576	East Area				3,644,951	45,941			94			
577	Cruz		1933	x	200,157	3,013						
578	Nutt		1935	x	3,444,794	42,928						
579	Main Area											
580	Baldwin "1-2-3"		1917	x	126,878,912	1,729,225			1,805			
581	West Area											
582	All Pools		1939	x	22,803,236	570,858			904			
583	Newport, Orange	Plio-Mio	1925	970	9,676,584	2,241,490			732			
584	Aldrich Area				1,780,656	307,518		712	61			
585	"B"		1945	x	1,366,691	275,043		316	24			
586	"C"		1946	x	413,965	32,475		397	37			
587	Anaheim Sugar Area		1946	x	2,846,933	1,173,198		684	394			
588	Mesa Area			x								
589	Cagney		1947	x	9,787	2,767						
590	West Newport Beach Area		1943	x	5,039,208	758,007			387			
591	Playa Del Rey, L. A.	Plio-Mio-Jur	1929	470	54,423,329	625,359		54,159	613			
592	Del Rey Hills Area		1934	x	10,465,851	155,419						
593	Venice Area											
594	All Pools		1929	x	43,957,478	469,940						
595	Potrero, L. A.	Plio-Mio	1927	150	7,243,348	467,396			6,556			
596	East Area (Inc. W/West Area-											
597	All Pools All Pools)		1928	x				3,663	282			
598	Inglewood City Area		1946	x	659,307	315,095		10,618	6,213			
599	West Area											

LINE NUMBER	NUMBER OF WELLS[6]			WELLS PRODUCING[7] DEC. 1949			RESERVOIR PRESSURE LB PER SQ INCH		SECONDARY RECOVERY[8]	CHARACTER OF OIL[9]		PRODUCING FORMATION					DEEPEST ZONE TESTED[11] TO END OF 1949	
	COMPLETED DURING 1949	FLOWING	ARTIFICIAL LIFT	SHUT IN	TOTAL	G A S	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[10]	POROSITY PER CENT[12]	DEPTH TO TOP OF PRODUCING ZONE FT.	PROD. THICKNESS AVG. FT. NET	STRUCTURE[13]	NAME	DEPTH OF HOLE, FT.
514			5		5													
515																		
516	1	14	19	3	36													
517		5	19	10	34													
518			1		1					30.4	1.15	S	28-23	3,800	1,500	A F	Miocene	
519	7	13	326	12	351													
520	1	2	24	1	28													
521	1		16	1	17													
522		2	8		10													
523																		
524		2	3		5													
525																		
526			193	4	197													
527	6	9	106	7	122													
528	1	3	17		20													
529			20	1	21													
530			15	1	16													
531			4		4													
532	5	6	42	3	51													
533			8	2	10													
534										30.4	1.15	S	28-23	3,800	1,500	A F	Miocene	
535			1		1													
536																		
537	3	3	4		7					35.0	0.5	S	21	7,900	70	A F L	Miocene	
538		7	5		12													
539																		
540																		
541										21.5	3.5	S Cg	x	6,890	50	A F	Shast-Jur (?)	
542			23	2	25					17.0	3.7	S Fra	x	6,825	115	A F	Shast-Jur (?)	
543			3	1	4					15.0-28.0	1.6	S	25	1,900	1,200	A M F	Miocene	
544	90	24	1,162	113	1,299													
545	3	4	360	31	395													
546	2		318	19	337													
547			28	11	39													
548		1	5		6													
549	1	3	9	1	13													
550																		
551	60	5	312	23	340													
552	11	5	80	21	106													
553	49		232	2	234													
554	27	15	489	59	563													
555	1	1	76	7	84													
556	26	14	413	52	479													
557																		
558			1		1					19.0-30.0	1.9	S	29	1,075	975	A F	Shast-Jur (?)	
559	30	8	342	10	380													
560	16		275	6	281													
561																		
562			35		35													
563	2		21	1	22													
564	1	1	16		17													
565	1	7	15	3	25					28.5	x	S Cg	x	5,600	50	A	Shast-Jur (?)	
566	2	1	9	1	11													
567			3		3													
568	2	1	6	1	8					25.0	1.45	S	30	2,377	1,650	A F	Cg. Shast	
569	34	3	1,125	34	1,162													
570	34	3	1,108	34	1,145													
571	11		1,082	34	1,116													
572	23	2	23		25													
573		1	3		4													
574			17		17					23.0-36.0	0.8	S	x	1,730	1,100	A	Miocene	
575	9		330	8	340													
576	2		8		8													
577			1		1													
578	2		7		7													
579																		
580	3		243	1	244													
581																		
582	4	2	79	7	88					17.0	x	S	x	1,700	100	A M	Miocene	
583	3		186	17	203													
584	2		26	5	31													
585	1		15	3	18													
586	1		11	2	13													
587	1		31	1	32													
588																		
589				3	3													
590			129	8	137					22.0	3.5	S Cg	x	3,350	200	A	Shast-Jur (?)	
591			115	1	116													
592			12	1	13													
593																		
594			103		103					42.0	2.0	S	29	3,640	350	A F	Miocene	
595	8	16	21	1	38													
596																		
597		3	15		18													
598	8	13	2	1	16													
599																		

TABLE I – CONTINUED OIL AND GAS PRODUCTION STATISTICS FOR CALIFORNIA IN 1949

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl	
				AREA PROVED ACRES	BARRELS TO END OF 1949	BARRELS DURING 1949	AREA PROVED ACRES	MILLION CU FT TO END OF 1949	MILLION CU FT DURING 1949		TO END OF 1949	DURING 1949
600	All Pools			x	6,584,041	152,301			61			
601	Richfield, Orange	Mio		1,485	111,966,858	2,347,223		160,911	1,925			
602	East Area - All Pools		1919	x	x	1,211,188			966			
603	West Area - All Pools		1920	x	x	1,136,035			959			
604	Rosecrans-Athens, L. A.	Plio-Mio		650	64,856,213	2,246,940		139,081	4,635			
605	Athens Area				x	107,250			602			
606	Upper		1925	x	x	35,590						
607	Lower		1924	x	x	154,391						
608	Rosecrans-Athens											
609	Athens Area											
610	O'Dea		1940		1,103,709	117,269						
611	Northwest Area											
612	'7 & 8'		1947		869,689	708,909		1,692	1,452			
613	Rosecrans Area				x	1,230,831			2,581			
614	Maxwell-Hage		1924		x	206,122			108			
615	Zana		1927		x	159,596			557			
616	O'Dea		1937		19,187,383	547,948			1,278			
617	Eighth		1937		1,945,855	150,330			345			
618	Rank '7 & 8'		1944		833,896	164,845		878	274			
619	Tank Vapor								19			
620	Santa Fe Springs, L. A.											
621	All Pools	Plio-Mio	1921	1,450	538,212,463	5,327,152		727,429	4,890			
622	Seal Beach, L. A.	Plio-Mio		670	118,222,746	4,381,435		110,274	2,833			
623	Alamitos Area											
624	All Pools		1926		26,018,062	179,032			161			
625	North Block				12,375,566	2,801,695						
626	San Gabriel		1945		373,947	41,156		157	20			
627	Selover		1940		224,543	24,310						
628	Wasem				2,250,308	273,429		2,101	240			
629	McGrath		1943		9,526,568	2,462,800		6,390	2,157			
630	South Block				79,829,118	1,400,708						
631	Ruby-Selover		1926		28,240,599	353,604						
632	Wasem		1927		42,559,590	829,770						
633	McGrath		1938		9,008,929	217,334			1,253			
634	Tank Vapor								2			
635	Torrance, L. A.	Mio	1922	6,100	138,147,880	2,761,939		90,967	1,489			
636	Hermosa Area				695,411	21,944						
637	Torrance Area				127,452,469	2,739,965						
638	Main		1922		108,370,601	2,003,356						
639	Thirty-four		1937		11,774,360	547,915						
640	D & B		1938		4,090,685	133,702						
641	Vesta		1940		3,216,623	254,992						
642	Whittier, L. A.	Pli-Mio		750	21,257,005	357,988			175			
643	Central Area		1898		x	213,892						
644	La Habra Area		1940		112,647	13,216						
645	Rideout Heights Area		1901		x	30,880						
646	Bartola Area				68,902							
647	Wilmington, L. A.	Pli-Mio-Jur	1935	6,650	460,469,337	43,509,393		438,691	49,338			
648	Terminal Area				151,402,278	12,054,375			16,092			
649	Fault Block 1				38,437,152	4,103,879			4,015			
650	Tar-Bunger-Terminal		1936		27,967,190	2,395,216			1,228			
651	Ford		1937		6,580,678	540,095		9,171	1,207			
652	'237'-Conglomerate-Schist		1946		3,889,284	1,168,568		4,668	1,590			
653	Wilmington											
654	Terminal Area											
655	Fault Block 2				77,592,011	4,770,467		81,135	7,570			
656	Tar-Bunger		1937	x	16,691,945	972,427		15,051	729			
657	Terminal U & L		1937	x	52,109,668	2,551,319		55,382	4,002			
658	U. P.		1942	x	939,590	15,329		1,059	32			
659	Ford		1937	x	5,842,094	913,509		7,446	2,128			
660	'237'-Conglomerate-Schist		1945	x	1,708,724	317,883		2,197	679			
661	Fault Block 3				35,673,115	3,180,029		44,482	4,507			
662	Tar-Bunger		1937	x	15,779,635	1,439,258		18,293	1,590			
663	Upper Terminal		1938	x	13,630,048	1,257,905		16,353	1,793			
664	Lower Terminal		1939	x	5,989,910	468,833		9,533	1,101			
665	U. P.		1943	x	283,522	14,033		282	23			
666	Harbor Area				229,717,524	27,216,622			31,418			
667	Fault Block 4				123,601,848	11,553,427		126,496	9,993			
668	Tar		1943	x	1,370,737	215,616		1,201	202			
669	Terminal U & L		1938	x	122,032,251	11,217,375		124,976	9,554			
670	U. P.		1938	x	198,860	120,436		319	237			
671	Fault Block 4-A											
672	'237'-Conglomerate-Schist		1945	x	6,115,476	790,076		10,587	1,801			
673	Fault Block 4-B											
674	'237'-Conglomerate-Schist		1946	x	11,797,552	1,131,484		19,817	1,803			
675	Fault Block 4-AB											
676	Ford		1945	x	8,497,465	1,597,329		10,692	3,091			
677	Fault Block 4-D											
678	U. P.-Ford-'237'		x	x	5,462,185	2,340,088			2,909			
679	Fault Block 4 & 5											
680	Bunger		1938	x	52,649,610	4,680,349			4,649			
681	Fault Block 5-A											
682	Terminal U & L		1939	x	9,388,364	389,376		7,759	288			
683	Fault Block 5-B				5,054,157	1,776,975		8,622	2,581			
684	Upper Terminal		1945	x	1,787,356	765,463		3,386	1,327			
685	Lower Terminal		1938	x	3,266,801	1,011,512		5,236	1,254			

LINE NUMBER	NUMBER OF WELLS[6]			WELLS PRODUCING[7] DEC. 1949			RESERVOIR PRESSURE LB. PER SQ. INCH		SECONDARY RECOVERY[8]	CHARACTER OF OIL[9]		PRODUCING FORMATION					DEEPEST ZONE TESTED[10] TO END OF 1949	
	COMPLETED DURING 1949	FLOWING	ARTIFICIAL LIFT	SHUT IN	TOTAL	GAS	INITIAL	AVG. END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[1]	POROSITY PER CENT[1]	DEPTH TO TOP OF PRODUCING ZONE FT.[8]	PROD. THICKNESS AVG. FT.[8,17]	STRUCTURE[18]	NAME	DEPTH OF HOLE, FT.
600			4		4													
601	18		334	14	348					30.5	1.8	S	18	2,900	750	A F	Oligocene	
602	14		249	12	261													
603	4		85	2	87					35.0	1.9	S	22	4,035	1,050	A F	Eocene	
604	17	15	196	6	217													
605	2		55	1	56													
606			13		13													
607			30		30													
608																		
609																		
610	2		12	1	13													
611																		
612	10	11	8		19													
613	5	4	133	5	142													
614			21		21													
615		1	22		23													
616	4	1	73	5	79													
617	1	1	15		16													
618		1	2		3													
619																		
620																		
621	5		525	23	548					32.0	0.9	S	29	3,200	1,360	D	Miocene	
622	7	35	163	6	204					26.0	1.5	S	x	4,300	350	A F	Miocene	
623																		
624			35	1	36													
625	7	35	42	2	79													
626			3		3													
627			4		4													
628	2	2	12	1	15													
629	5	33	23	1	57													
630			86	3	89													
631			23	3	26													
632			45		45													
633			18		18													
634										14.0-26.0	2.5	S	27	2,637	120	A F	Schist-Jur (?)	
635	6		760	19	779													
636			6		6													
637	6		754	19	773													
638	6		539	12	551													
639			130	3	133													
640			28	3	31													
641			57	1	58					19.0-27.0	1.2	S	x	300	270	SUF	Miocene	
642	1		99	61	160													
643			82	59	141													
644			8	1	9													
645	1		9	1	10													
646										13.0-31.0	2.0	S (a)	28-32	2,320	980	A F	Schist-Jur (?)	
647	148	90	1,832	251	2,173													
648	31	51	390	125	566													
649	14	5	163	7	175													
650	11		117	6	141													
651	2	2	28	1	31													
652	1	3	18	2	23													
653																		
654																		
655	13	22	141	89	252													
656	2		45	55	100													
657	5	12	64	27	103													
658			1	3	4													
659	3	10	22	3	35													
660	3		9	1	10													
661	4	24	86	29	139													
662	1	3	66	22	91													
663	2	12	12	7	31													
664	1	9	7		16													
665			1		1													
666	102	39	884	109	1,032													
667	44	5	260	29	294													
668	2	2	7	16	25													
669	38		250	12	262													
670	4	3	3	1	7													
671																		
672	3	2	22	9	33													
673																		
674			43	6	49													
675																		
676	5	4	35	16	55													
677																		
678	6		81		81													
679																		
680	15		342	31	373													
681																		
682			14		14													
683	16	21	9	14	44													
684	10	11	3	6	20													
685	6	10	6	8	24													

TABLE I - CONTINUED OIL AND GAS PRODUCTION STASTICS FOR CALIFORNIA IN 1949

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl	
				AREA PROVED ACRES	BARRELS TO END OF 1949	BARRELS DURING 1949	AREA PROVED ACRES	MILLION CU FT[c] TO END OF 1949	MILLION CU FT[c] DURING 1949		TO END OF 1949	DURING 1949
686	Fault Block 6				7,150,867	2,957,518		9,320	4,303			
687	Berger		x	x	5,385,045	1,655,306		7,150	2,707			
688	Upper Terminal		1948	x	939,644	691,330		1,326	1,019			
689	Lower Terminal		1948	x	826,178	610,892		844	577			
690	Town Lot Area			79,349,535	4,238,396				1,802			
691	Tar-Bunger-Terminal		x	x	x	4,013,131			1,564			
692	Ford		x	x	x	225,265			258			
693	Tank Vapor								26			
694	Other Fields				76,156,894	578,961						
695	Belmont Off-Shore	Mio	1948	10	15,415	12,904		4	2			
696	Beverly Hills		1900	x	4,072,371	31,897			3			
697	Buena Park, *Orange*	Plio-Mio	1942		231,630	11,993			5			
698	East Area		1942	40	180,047	8,225						
699	West Area		1944	40	51,583	3,738						
700	Chino, *San Bernardino*	Mio	1931	30	6,500	225						
701	Kraemer, *Orange*	Plio-Mio	1918	170	1,776,833	31,795		19	14			
702	La Mirada		1946	x	20,571							
703	Leffingwell, *L. A.*		1946	20	19,304	1,924		29	18			
704	Los Angeles, *L. A.*	Plio-Mio	1892	x	20,227,555	63,960						
705	North Whittier Heights		1944	10	26,823	3,330						
706	Puente Hills, *L. A.*	Mio	1880	150	1,290,153	19,570		20	12			
707	Salt Lake	Mio	1902	1,435	43,051,843	49,970		92	80			
708	Sansinena, *L. A.*		1945	275	216,796	124,714		54	26			
709	Turnbull, *L. A.*		1941	60	539,522	31,194						
710	Walnut		1948	10	8,265	5,893						
711	Western Avenue		1940	20	44,174	1,792						
712	Yorba Linda, *Orange*	Plio-Mio	1937	300	2,609,229	187,830		70	22			
713	Shell				1,105,425	123,227						
714	Smith				1,503,804	64,603						
715	Unidentified							196,343				
716												
717	Los Angeles Region Total				3,710,556,941	119,037,243		4,290,663	126,029			
718												
719	State Total				8,317,038,290	332,942,156		10,631,135	413,954			

LINE NUMBER	NUMBER OF WELLS[e]			WELLS PRODUCING[f] DEC. 1949			RESERVOIR PRESSURE LB PER SQ INCH		SECONDARY RECOVERY[g]	CHARACTER OF OIL[h]		PRODUCING FORMATION					DEEPEST ZONE TESTED[n] TO END OF 1949	
	COMPLETED DURING 1949	FLOWING	ARTIFICIAL LIFT	SHUT IN	TOTAL	GAS	INITIAL	AVG. /END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT[k]	PROD. THICKNESS AVG. FT / NET	STRUCTURE[m]	NAME	DEPTH OF HOLE, FT
686	13	7	78	4	89													
687	3		60		60													
688	5	4	6	3	13													
689	1	3	3	1	7													
690	15		558	17	575													
691	14		528	17	545													
692	1		30		30													
693																		
694	12	5	130	21	156					26.0	x	S	x	x	x	x	x	
695			1		1													
696			2		2					34.0	2.42	S	x	8,900	60	A M	Miocene	
697			2		2													
698			1		1													
699			1		1					23.0	x	S	x	3,700	100	A F	Miocene	
700				1	1					19.0	x	S	x	2,275	x	A	(See Inchfield)	
701	1		12	1	13													
702																		
703			1		1					15.5	1.0	S	x	155	20	A F	Miocene	
704			80		80													
705			1	1	2					18.0-25.0	x	S	x	500	x	A F	x	
706	2		2	2	4													
707			5		5					19.9	x	S	x	3,400	360	M F	Miocene	
708	6	5	1		6													
709			5		5													
710	1		2		2													
711			1		1					14.0	x	S	x	2,170	130	A M	Miocene	
712	2		15	16	31													
713	2			14	14													
714			15	2	17													
715																		
716																		
717	441	251	8,520	714	9,485													
718																		
719	1,723	1,849	22,492	4,910	29,251													

TABLE I-A DRY GAS FIELD STATISTICS FOR CALIFORNIA DURING 1949

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	GAS PRODUCTION AREA PROVED ACRES	GAS PRODUCTION MILLION CU FT[c] TO END OF 1949	GAS PRODUCTION MILLION CU FT[c] DURING 1949	GAS PRODUCTION AREA PROVED ACRES	GAS PRODUCTION MILLION CU FT[c] TO END OF 1949	GAS PRODUCTION MILLION CU FT[c] DURING 1949	GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl TO END OF 1949	CONDENSATE PRODUCTION Thousands of Bbl DURING 1949
1	Afton, *Glenn*	Capay, Eocene	1944	500	1,502,692	821,134						
2	Alpaugh, *Kings*	San Joaquin Clays, Plio	1948	500	444,691	215,094						
3	Bowerbank, *Kern*	San Joaquin Clays, Plio	1942	530	3,879,612	131,185						
4	Buena Vista Hills, *Kern*	San Joaquin Clays, Plio	1907	2,000	121,430,351	597,313						
5	Buttonwillow, *Kern*	San Joaquin Clays, Plio	1927	1,700	34,450,095	142,365						
6	Cache Slough, *Solano*	Capay, Eocene	1945	450	4,395,605	1,681,937						
7	Chico, *Butte*	Upper Cretaceous	1944	600	563,133	114,945						
8	Chowchilla (Upper), *Madera*	Zilch, Miocene	1936	2,400	?							
9	Chowchilla (Lower)	Cretaceous	1934		?							
10	Coles Levee (North), *Kern*	San Joaquin Clays, Plio	1941	850	25,391,409	2,112,531						
11	Coles Levee (South), *Kern*	San Joaquin Clays, Plio	1941									
12	Corning, *Tehama*	Eocene	1944	x	?							
13	Dominguez, *Los Angeles*	Pliocene		x	383,775							
14	Dudley Ridge, *Kings (Tulare L)*	Tulare, Pleis	1929	x	2,053,300							
15	Dunnigan Hills, *Yolo*	Capay, Eocene	1946	1,000	856	285						
16	Durham, *Butte*	Cretaceous	1946	350	104,800	101,319						
17	Elk Hills, *Kern*	San Joaquin Clays, Plio	1919	5,000	86,563,782	1,815,066						
18	El Segundo, *Los Angeles*	Upper Pico, Pliocene	1940	150	7,953,352	292,433						
19	Fairfield Knolls, *Yolo*	Capay, Eocene	1937	800	1,365,893	274,143						
20	Galt (A)	Eocene			633,574	194,703						
21	Gill Ranch, *Madera*	Eocene	1943	x	11,999,774	2,781,135						
22	Goleta, *Santa Barbara*	Vaqueros, Miocene	1929	x	15,436,641	(storage)						
23	Honker, *Solano*		1944	x	299,730	3,617						
24	Kirby Hills, *Solano*	Eocene	1945	1,250	10,400,099	3,715,880						
25	Lodi, *San Joaquin*	Eocene	1943	1,500	3,931,940	1,154,938						
26	Long Beach, *Los Angeles*	Pliocene	1926	x	1,475,876							
27	Main Prairie, *Solano*	Eocene	1945	1,500	5,129,732	1,892,739						
28	Marysville Buttes, *Sutter*	Upper Cretaceous	1933	2,000	9,868,950	630,068						
29	Mcdonald Island, *San Joaquin*	Capay, Eocene	1936	x	97,126,755	1,823,357						
30	McKittrick, *Kern*	Pliocene	1925	x	1,032,953							
31	Miller (Union), *Solano*	Eocene, Miocene	1944	1,300	5,563,714	1,548,241						
32	Moffet (Firebaugh), *Madera*	Kreyenhagen, Eocene	1941	x	453,639	239,864						
33	Newport (West), *Orange*			x	15,562							
34	North Midway, *Kern*	Pliocene		x	1,826,381							
35	Ord Bend, *Glenn*	Upper Cretaceous	1943	750	3,794,806	765,500						
36	Paloma, *Kern (Buena Vista L.)*	Etchegoin, Pliocene	1934	x	5,124,657	675						
37	Petaluma, *Sonoma*	Pliocene	1942	x	28,194							
38	Pleasant Creek, *Yolo*	Meganos, Eocene	1948	x	2,569	2,049						
39	Potrero Hills, *Solano*	Upper Cretaceous	1942	x	39,042							
40	Rio Vista, *Sacramento, Solano & Contra Costa*			x	1,134,653,964	124,841,977						
41	Ruhkopf Pools	Domengine, Eocene	1936	x								
42	Midland Pool	Capay, Eocene	1943	x								
43	Hamilton Pool	Capay, Eocene	1936	x								
44	Anderson Pool	Meganos, Eocene	1944	x								
45	Refugio, *Santa Barbara*	Sespe, Oligocene	1947	x	95,298							
46	Roberts Island, *San Joaquin*	Paleocene	1942	300	3,089,193	321,411						
47	Rosecrans, *Los Angeles*		1943	x	45,633							
48	Santa Fe Springs, *Los Angeles*	Pliocene		x	8,333,127							
49	Seal Beach, *Los Angeles*	Miocene	1932	x	777,660							
50	Semitropic, *Kern*	San Joaquin Clays, Plio	1935	3,825	13,418,512	635,918						
51	Suisun Bay, *Solano*	Capay, Eocene	1944	1,000	6,748,272	2,391,227						
52	Summerland, *Santa Barbara-Williams Pool*	Sespe, Oligocene	1948	x	552,469	537,624						
53	Thornton, *Sacramento & San Joaquin*	Capay, Eocene	1943	x	10,539,142	3,926,117						
54	Hopkins Hills (Buehal), *Humboldt*	Pliocene	1937	x	6,493,741	1,310,690						
55	Tracy, *San Joaquin*	Panoche, Cretaceous	1935	640	12,684,570	289,255						
56	Trico (South Mya), *Kings*	San Joaquin Clays, Plio	1934	x	39,301,487	2,976,808						
57	(North Mya), *Tulare*		1946	x	8,053,971	2,432,421						
58	(Atwell), *Kern*		1945	x	8,158,882	1,499,149						
59	Vernalis, *Stanislaus & San Joaquin*	Upper Cretaceous	1941	600	7,709,243	652,699						
60	Willows, *Glenn*	Upper Cretaceous	1938	200	25,384							
61	Winters, *Solano*		1946	1,300	1,206,974	1,203,684						
62	Denverton, *Solano*		1948	x	56,949	23,376						

(A) Formerly included in Lodi.

LINE NUMBER	NUMBER OF WELLS[C]			WELLS PRODUCING[F] DEC. 1949			RESERVOIR PRESSURE LB. PER SQ. INCH		BTU OF GAS	CHARACTER OF OIL[A]		PRODUCING FORMATION					DEEPEST ZONE TESTED[D] TO END OF 1949	
	COMPLETED TO END 1949	1949 COMPLETED	1949 ABANDONED	PRODUCING	SHUT-IN	TOTAL	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[I]	POROSITY PER CENT[J]	DEPTH TO TOP OF PRODUCING ZONE, FT.	PROD. THICKNESS AVG. FT. / NET	STRUCTURE[K]	NAME	DEPTH OF HOLE, FT.
1	2	0	0	2	0	2	1,075		840			S	31	2,648	12	A	Cretaceous	
2	1	0	0	1	0	1	x		1,010			S	30	3,420	85	A	Pliocene	
3	3	0	0	2	1	3	1,700		1,017			S	30	4,300	20	A	Miocene	
4	66	0	0	17	1	18	x		980			S	32	1,700	90	A	Miocene	
5	34	1	3	1	0	1	1,000		965			S	x	2,900	18	D	Miocene	
6	5	0	0	3	2	5	1,900		1,020			S	x	4,765	45	F A	Eocene	
7	2	0	0	1	0	1	1,900		860			S	25	4,965	12	A	Basement	
8	2	0	0	0	0	0	1,040		874			S	24	3,440	25	A	Schist	
9	1	0	0									S	24	7,925	x	A	Schist	
10	6	0	0	5	1	6	2,360		1,020			S-Sb	x	5,200	40	A L	Miocene	
11																		
12	5	3	0	0	0	0	660		x			S	35	1,070	100	A	Cretaceous	
13	2	0	0	0	0	0	x		x			S	x	3,485	50	A D	Miocene	
14	8	0	0	0	0	0	x		900			S	x	1,090	x	x	Pliocene	
15	6	0	0	0	6	6	975		x			S	x	2,570	25	A	Cretaceous	
16	4	0	0	3	1	4	840		x			S	x	2,090	6	A	Cretaceous	
17	6	0	0	3	3	6	x		980			S	38	1,150	75	A	Miocene	
18	9	0	0	5	3	8	2,000		995			S	28	1,994	20	D	Schist	
19	2	0	0	1	1	2	1,900		945			S	x	3,662	20	A	Cretaceous	
20	1	0	0	1	0	1												
21	10	1	0	10	0	10	1,950		960			S	30	4,479	30	A F	Basement	
22	11	2	0	(Storage)			1,955		1,055			S	x	4,064	250	A F	Eocene	
23	2	1	1	0	1	1	1,360		x			S	25	7,190	100	A(?)	Cretaceous	
24	9	0	0	6	3	9	1,126-2,300		1,003			S	x	1,810	35	A	Cretaceous	
25	4	0	0	4	0	4	934		740			S	30	2,330	35	A	Basement	
26	x	0	0	0	0	0	x		960			S	x	x	x	A F	Miocene	
27	3	0	0	2	0	2	1,911		1,025			S	25	4,740	30	A	Eocene	
28	6	0	0	6	0	6	2,950		1,000			S	28	2,700	50	M D	Basement	
29	12	5	2	5	2	7	2,280		980			S	30	5,140	90	D	Cretaceous	
30	2	0	0	0	0	0	x		990			x	x	x	x	x	Eocene	
31	4	0	0	3	0	3	1,865		985			S	25	4,550	50	A	Cretaceous	
32	2	1	0	2	0	2	1,710		960			S	30	3,990	40	A	Cretaceous	
33	1	0	0	0	0	0	x		x			S	x	x	x	x	Miocene	
34	3	0	0	0	0	0	x		x			S	x	x	x	x	Miocene	
35	3	0	0	3	0	3	1,480		x			S	x	3,654	20	A	Cretaceous	
36	6	0	0	0	1	1	1,660		1,020			S	30	5,180	20	A	Miocene	
37	2	0	0	0	0	0	x		x			S	x	1,182	30	x	Pliocene	
38	2	1	0	0	2	2	x		x			S	x	2,783	25	x	Eocene	
39	1	0	0	0	0	0										A F	Cretaceous	
40	155	12	0	138	17	155			1,035									
41							1,700 W 1,590 E					S	35	4,200 W 3,800 E	150 W 170 E			
42							2,000					S	35	4,300	90			
43							2,127					S	30	5,217	100			
44							2,220					S	30	6,200	50			
45	2	0	0	0	2	2	x		x			S	x	2,605	x	x	x	
46	1	0	0	1	0	1	2,063		1,040			S	x	5,235	10	A	Basement	
47		0	0	0	0	0	x		x			S	x	x	x	x	Miocene	
48		0	0	0	0	0	x		980			S	x	2,500	20	D	Miocene	
49		0	0	0	0	0	x		1,013			S	x	x	x	A F	Miocene	
50	22	0	0	3	2	5	1,110		990			S	25	2,380	6	A	Miocene	
51	3	0	0	2	1	3	x		x			S	x	3,890	100	A	Cretaceous	
52	2	1	0	1	1	2	x		x			S	x	3,038	200	x	Oligocene	
53	10	1	0	10	0	10	1,375		950			S	30	3,264	40	A	Cretaceous	
54	6	1	0	5	0	5	2,488		1,040			Sb	26	3,764	170	A	Pliocene	
55	6	0	0	2	0	2	1,750		900			S	28	3,923	65	D	Cretaceous	
56		2	1	25	5	30	1,175		990			S	28	2,395	13	A	Eocene	
57	81	1	1	21	5	26			990			S	28	2,395		A	Eocene	
58		1	1	18	4	22			1,016			S	28	3,170		A	Eocene	
59	2	0	0	2	0	2	1,630		900			S	x	3,840	30	A	Cretaceous	
60	2	0	0	0	0	0	675		985			S	27	2,290	10	D	Cretaceous	
61	5	0	0	3	2	5	2,200		850			S	x	4,855	25	A	Cretaceous	
62	2	0	1	0	1	1	x		x			S	x	1,868	32	x	Cretaceous	

TABLE I -- OIL AND GAS OPERATIONS IN WEST VIRGINIA BY COUNTIES, 1949

COUNTY	PERMITS TO DRILL OR DEEPEN	COMPLETIONS						RANGE IN DEPTH (FT)	TOTAL FOOTAGE DRILLED	AVERAGE DEPTH OF WELLS (FT)	TOTAL INITIAL DAILY GAS MCF	RANGE IN SIZE OF GAS WELLS MCF	TOTAL INITIAL DAILY OIL BBL	RANGE IN SIZE OF OIL WELLS BBL	NUMBER OF DRILLING WELLS OR COMPLETIONS NOT REPORTED AT END OF YEAR
		GAS WELLS	OIL WELLS	OIL AND GAS WELLS	STORAGE BRINE, AND WATER INJECTION WELLS	DRY HOLES	TOTAL								
Barbour	5	5	-	-	-	4	9	2,250 - 4,414	29,837	4,302	1,681	96 - 1,196	-	-	0
Boone	11	12	-	-	-	1	13	1,592 - 4,242	39,663	3,051	4,899	47 - 2,783	-	-	5
Braxton	12	4	-	1	-	3	8	1,600 - 2,550	16,041	2,005	374	29 - 189	10	10	8
Brooke	4	-	2	-	-	-	2	1,366 - 1,439	2,802	1,401	-	-	10	5	3
Cabell	2	2	-	-	-	-	2	3,300 - 3,560	6,860	3,430	270	50 - 220	-	-	1
Calhoun	81	13	9	5	-	5	32	1,486 - 2,633	67,560	2,111	9,245	21 - 6,219	100	3 - 18	15
Clay	8	1	-	-	-	2	3	973 - 2,410	4,429	1,476	253	253	-	-	6
Doddridge	5	3	2	-	-	1	6	795 - 2,680	9,909	1,651	400	100 - 154	14	4 - 10	2
Fayette	1	-	-	-	-	-	1	-	2,901	2,901	157	157	-	-	1
Gilmer	43	25	1	2	3	12	45	800 - 3,525	87,349	1,941	9,360	26 - 1,063	25	2 - 20	6
Hancock	4	2	-	-	-	2	4	310 - 1,290	4,057	1,014	14	6 - 10	-	-	1
Harrison	4	3	-	-	-	-	3	3,049 - 3,348	9,427	3,238	197	43 - 154	-	-	2
Jackson	43	3	24	2	-	13	42	840 - 6,283	108,735	2,589	2,492	25 - 1,200	355	2 - 30	10
Kanawha	28	20	9	-	15	9	53	1,125 - 6,694	177,377	3,347	52,134	33 -25,000	55.50	1 - 15	3
Lewis	14	10	-	-	-	6	16	2,173 - 4,628	68,492	3,031	2,712	21 - 1,302	-	-	3
Lincoln	34	42	-	-	-	1	43	718 - 4,377	139,319	3,240	19,313	26 - 2,518	-	-	21
Logan	12	8	-	1	-	3	12	2,235 - 4,107	38,821	3,235	5,522	51 - 1,750	4	4	6
McDowell	14	8	-	-	-	5	13	2,691 - 7,576	54,653	4,204	6,795	61 - 4,140	-	-	9
Marion	16	3	-	-	3	6	16	1,002 - 3,517	35,343	2,209	359	82 - 169	-	-	3
Marshall	12	15	-	-	1	2	18	1,049 - 6,809	36,119	2,007	36,479	24 -12,681	-	-	4
Mason	1	2	-	-	-	2	4	3,790 - 3,915	15,303	3,826	81	21 - 60	-	-	2
Mercer	0	1	-	-	-	-	1	4,014	4,014	4,014	15	15	-	-	0
Mingo	14	30	-	-	-	-	30	1,345 - 3,862	60,534	3,027	15,634	50 - 8,347	-	-	7
Monongalia	3	2	-	1	-	-	3	1,365 - 2,955	5,699	1,900	233	29 - 130	1	1	1
Nicholas	7	9	-	-	-	-	9	1,432 - 2,500	18,269	2,030	9,415	41 - 2,041	-	-	1
Pleasants	17	3	3	4	-	4	14	478 - 2,800	22,344	1,597	1,103	19 - 350	29.50	0.50 - 16	4
Preston	6	3	-	-	-	3	6	5,365 - 8,635	37,682	6,280	4,255	184 - 2,071	-	-	2
Putnam	35	23	-	-	-	2	25	1,860 - 5,100	76,968	3,080	19,210	15 - 7,805	-	-	14
Raleigh	39	37	-	-	-	2	39	1,525 - 3,701	96,709	2,479	36,709	39 - 2,623	-	-	7
Randolph	0	-	-	-	-	-	-	-	-	-	-	-	-	-	(at 6,047') 1
Ritchie	31	2	8	6	-	10	31	524 - 5,810	63,200	2,039	2,113	55 - 500	63	1 - 15	15
Roane	18	5	5	-	-	4	14	1,488 - 2,595	25,070	1,791	2,405	60 - 1,641	35	3 - 12	13
Tucker	1	1	-	-	-	-	1	-	8,175	8,175	537	537	-	-	1
Tyler	13	-	3	-	-	8	11	1,091 - 2,585	20,619	1,874	-	-	42	2 - 30	5
Upshur	30	16	1	-	-	1	18	1,102 - 4,832	61,302	3,406	4,610	33 - 988	50±	50±	6
Wayne	68	64	-	1	-	10	75	962 - 2,900	226,273	3,017	21,121	21 - 2,100	2	2	28
Webster	0	-	-	-	-	1	1	- 2,448	2,448	-	-	-	-	-	0
Wetzel	15	2	-	-	-	3	5	760 - 3,202	7,982	1,594	153	33 - 128	-	-	14
Wirt	15	2	4	1	1	1	9	235 - 3,350	14,106	1,567	640	40 - 400	19	2 - 10	9
Wood	35	2	7	-	-	10	24	56 - 5,693	52,933	2,298	27,309	389 -20,000	27.75	0.25 - 20	12
Wyoming	37	42	-	-	-	10	52	1,762 - 4,528	165,114	3,243	52,576	32 - 5,206	-	-	12
Totals, 1949	813	427	78	24	27	144	700	56 - 8,635	1,906,475	2,724	352,117	6 -25,000	842.75	0.25 - 50±	271
Totals, 1948	923	590	131	26	9	178	934	283 - 8,942	2,520,757	2,699	491,441	6 -24,000	2,478.75	0.25 -130	333
Totals, 1947	976	644	93	25	9	171	942	385 - 8,120	2,570,198	2,819	506,672	10 -18,151	1,567	0.25 -380	330

Oil And Gas Developments In West Virginia During 1949

GENERAL

A total of 700 wells were drilled in West Virginia during 1949. This figure represents a 25 per cent decrease in drilling activity under the 1948 figure. Of the 1949 figure, 427 completions were gas wells; 78 were oil wells; 24 were oil and gas; 27 were storage, brine and water-intake wells; and 144 were dry holes. There was a 40 per cent drop in oil well drilling under the previous year's figure and a 27 per cent drop in gas wells. Oil and gas wells were 8 per cent less in number than during 1948. Although dry holes dropped percentagewise by 18 per cent, the percentage of dry holes to completions increased about 20 per cent during 1949.

Well depths ranged from 56 to 8,635 ft and total footage drilled decreased 614,282 under the 1948 figure, representing a 24 per cent drop. The total initial daily open flow of gas wells was 352,117 Mcf and the size of the gas wells ranged from 6 to 25,000 Mcf, as compared with 6 to 24,000 Mcf in 1948. The total daily initial oil during the past year was 842.75 bbl, representing a 34 per cent drop under the 1948 figure. Size of oil wells ranged from .25 bbl to 50± bbl during 1949, compared with .25 to 130 bbl in 1948.

Estimates of production for 1949 are as follows: gas, 181,380,000 Mcf; oil 2,852,500 bbl. The estimated number of producing wells at the end of 1949 are: gas 13,800, and oil, 15,000. The accompanying table reveals the statistics of activities in West Virginia by counties.

N
47°
48°
IRAN
BASRA
ABADAN
IRAQ
30°
BUBIYAN ISLAND
KUWAIT
Bahra
PERSIAN GULF
KUWAIT
Jahra
Madaniyat
AHMADI
Mena al Ahmadi (Shipping Terminal)
29°
Burgan Field
NEUTRAL ZONE
SAUDI ARABIA
10 Miles
D.M.D.
K.O.C. LONDON

Oil And Gas Developments In Bahrein Island, Saudi Arabia And Qatar During 1949

By BAHREIN PETROLEUM COMPANY LIMITED, J. T. DUCE * and N. E. BAKER **

BAHREIN

Production for the year 1949 for Bahrein Island was 10,985,484 bbl. Two new wells were completed in the Bahrein Zone, one deep test well was suspended at a depth of 10,078 ft, and a second deep test was drilling below 5,100 ft at the end of the year.

The Bahrein refinery had a total through-put of 56,059,699 bbl of crude, which was supplied by the Bahrein Field and by pipeline from the Arabian Fields.

SAUDI ARABIA

Production in Saudi Arabia during the year 1949 was 174,008,629 bbl, of which 138,080,401 was produced from Abqaiq, 31,366,265 bbl from Dammam, and 4,561,963 bbl from Qatif. The following new wells were completed during 1949:

11 at Abqaiq
5 at Ain Dar
1 at Dammam
1 at Fadhili
3 at Haradh
3 at Qatif

At the end of 1949, a total of 123 wells had been drilled. One hundred and four of these wells are capable of production, although production facilities are not installed for all of the wells. Twelve of the 104 wells are in fields that have no producing facilities.

During the year, successful wildcats were completed at Haradh and Fadhili. Haradh is located approximately 150 miles southwest of Dhahran. Fadhili is located approximately 70 miles northwest of Dhahran.

The average through-put of the Ras Tanura refinery was 126,766 B/D. per day.

Construction is continuing on the Trans-Arabian Pipe Line. Approximately one-half of the pipe had been welded by the end of 1949. Construction work on the pipe line is being done from both the eastern and western ends of the line.

During the year, geological and geophysical investigations consisted of three surface mapping parties, two gravity meter parties, one marine seismograph party, and two structure drill parties. Two survey parties were doing triangulation and level work.

QATAR

Seven producing wells were completed by the end of 1949 making the total number of producers ten. These are on the Dukhan structure in Western Qatar. Two drilling strings continue in operation.

A sixty mile pipeline of 14½ inch diameter was completed from Dukhan to Im Said on the east coast. The first shipment of Qatar crude was made December 31, 1949, and the field was thus put on a producing and shipping basis, with some two million tons per year the present production objective.

A lower productive horizon (No. 4 Limestone) was proven during 1949. This is about 150 feet below the No. 3 Limestone pay. Both correlate with the Arab Zone of Saudi Arabia and are Jurassic in age.

A gravity survey was conducted over the main Qatar Peninsula and it is intended to follow this with a seismic survey.

* MEMBER AIME. V. PRES. ARABIAN AMERICAN OIL CO., 711 5TH AVE., NEW YORK, N. Y.
** MEMBER AIME. CHIEF GEOL., IRAQ PET. CO., LTD., AND ASSOC. COMPANIES, Rm. 930, 500 5TH AVE., NEW YORK 18, N.Y.
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TABLE I - OIL AND GAS PRODUCTION STATISTICS FOR BAHREIN ISLAND IN 1949

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION AREA PROVED ACRES	OIL PRODUCTION BARRELS TO END OF 1949	OIL PRODUCTION BARRELS DURING 1949	GAS PRODUCTION AREA PROVED ACRES	GAS PRODUCTION MILLION CU FT[c] TO END OF 1949	GAS PRODUCTION MILLION CU FT[c] DURING 1949	GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl TO END OF 1949	CONDENSATE PRODUCTION Thousands of Bbl DURING 1949
1	Bahrein	Bahrein Zone, Cret M	1932	10,000	109,899,555	10,985,484				.153		

TABLE I - OIL AND GAS PPODUCTION STATISTICS FOR SAUDI AFABIA IN 1949

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION AREA PROVED ACRES	OIL PRODUCTION BARRELS TO END OF 1949	OIL PRODUCTION BARRELS DURING 1949	GAS PRODUCTION AREA PROVED ACRES	GAS PRODUCTION MILLION CU FT[c] TO END OF 1949	GAS PRODUCTION MILLION CU FT[c] DURING 1949	GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl TO END OF 1949	CONDENSATE PRODUCTION Thousands of Bbl DURING 1949
1	Abqaiq	Arab Zone, Jur U	1941	70,800	321,995,813	138,080,401		None Produced				
2	Abu Hadriya	Hadriya Zone , Jur M	1940		9,579	None		None Produced				
3	Ain Dar	Arab Zone, Jur U	1948	26,300	None	None		None Produced				
4	Dammam	Arab and Bahrein Zones Jur U and Cre M	1936	9,100	186,439,980	31,366,765		None Produced				
5	Fadhili	Fadhili Zone, Jur L ?	1949		None	None		None Produced				
6	Harnadh	Arab Zone, Jur U	1949	8,300	None	None		None Produced				
7	Qatif	Arab Zone Jur U	1945	15,300	10,614,481	4,561,963		None Produced				

LINE NUMBER	NUMBER OF WELLS[e]			WELLS PRODUCING[f] DEC. 1949			RESERVOIR PRESSURE LB PER SQ INCH		SECONDARY RECOVERY[g]	CHARACTER OF OIL[h]		PRODUCING FORMATION					DEEPEST ZONE TESTED[n] TO END OF 1949	
	COMPLETED TO END 1949	1949		OIL		GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT[k]	PROD. THICKNESS AVG. FT / NET	STRUCTURE[m]	NAME	DEPTH OF HOLE, FT
		COMPLETED	ABANDONED	FLOWING	ARTIFICIAL LIFT													
1	88	2	0	57						33.5	.2	L S	15-30	2,000	200	A F	Fourth Pay	5,225

J. T. DUCE

LINE NUMBER	NUMBER OF WELLS[e]			WELLS PRODUCING[f] DEC. 1949			RESERVOIR PRESSURE LB PER SQ INCH		SECONDARY RECOVERY[g]	CHARACTER OF OIL[h]		PRODUCING FORMATION					DEEPEST ZONE TESTED[n] TO END OF 1949	
	COMPLETED TO END 1949	1949		OIL		GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT[k]	PROD. THICKNESS AVG. FT / NET	STRUCTURE[m]	NAME	DEPTH OF HOLE, FT
		COMPLETED	ABANDONED	FLOWING	ARTIFICIAL LIFT													
1	59	11	0	42	0	0	2,440/ 3,395*			39	L.2	O L	20	5,600	245	A	Tuwaiq Oolite	11,209
2	1	0	0	0	0	0	4,800			36	L.7	L	-	10,115	120	-	Hadriya Zone	10,220
3	4	5	0	0	0	0	3,212			34	L.6	L-OL	-	6,623	162	A	Arab Zone	7,085
4	39	1	2	31	1	1	2,258			34	L.5	L-OL	21	6,200	400	D	Arab Zone	4,990
5	1	1	0	0	0	0	4,752			38	L.1	L	-	9,786	-	-	Fadhili Zone	10,675
6	3	3	0	0	0	0	2,900			34	2.5	L-OL	-	6,185	-	-	Arab Zone	6,530
7	9	3	0	3	0	0	3,556			30/38*	L.4 2.5	L O L	15/21*	6,912	187	-	Arab Zone	7,657

* Different Zones

TABLE 2 - SUMMARY OF DRILLING OPERATION FOR BAHREIN ISLAND

IMPORTANT WILDCATS DRILLED IN 1949														
LINE NUMBER	COUNTY OR LOCALITY	LOCATION			TOTAL DEPTH, FT. OR METERS	FORMATION	DEEPEST HORIZON TESTED	DRILLED BY	INITIAL PRODUCTION PER DAY			CHOKE, FRACTIONS OF AN INCH	PRESSURE, LB. PER SQ. IN.		REMARKS
		SEC. SURVEY	TWP. LAT.	RGE. LONG.					OIL, U.S. BBL.	GAS, MILLIONS CU. FT.	CONDENSATE U.S. BBL.		CASING	TUBING	
1	Bahrein Is.	26°03'N		51°35'E	10,078			Brown Drilling Co.							Suspended Drilling
2	Bahrein Is.	26°03'N		51°36'E	6,750			Brown Drilling Co.							

TABLE 2 - SUMMARY OF DRILLING OPERATIONS IN SAUDI ARABIA

IMPORTANT WILDCATS DRILLED IN 1949														
LINE NUMBER	COUNTY OR LOCALITY	LOCATION			TOTAL DEPTH, FT. OR METERS	FORMATION	DEEPEST HORIZON TESTED	DRILLED BY	INITIAL PRODUCTION PER DAY			CHOKE, FRACTIONS OF AN INCH	PRESSURE, LB. PER SQ. IN.		REMARKS
		SEC. SURVEY	TWP. LAT.	RGE. LONG.					OIL, U.S. BBL.	GAS, MILLIONS CU. FT.	CONDENSATE U.S. BBL.		CASING	TUBING	
1	Fadhili No. 1	26°37'	N	49°13'E	10,675		Fadhili Zone	Arabian American Oil Co.							Discv. New Field
2	Harath No. 1	26°14'	N	49°04'E	6,477		Arab Zone	Arabian American Oil Co.							Discv. New Field

Oil And Gas Developments In Burma, India And Pakistan During 1949

BURMA

Although during 1948 some further progress had been made towards the restoration of the Burma Fields after the scorched-earth policy applied in the face of the Japanese invasion, operations were becoming increasingly difficult. During 1949 owing to the disturbed condition of the country no progress could be made on work on the pipe line, whilst reconstruction in the oilfields was on a reduced scale, and by the end of the year had been almost completely brought to a standstill. The principal reconditioning work was on the wells in the Lanywa Field, a large proportion of the Chauk wells having already been repaired. In the absence of the pipe line, andof refining facilities, production from the repaired wells has been limited to the small amount required for the improvised topping plant at Chauk. Even this small plant has been run with a restricted output owing to the impossibility of regular dispatch of petroleum products even to nearby markets such as Mandalay.

Early in the year the oilfield area passed out of the control of the Government of Burma, but in June government forces reoccupied Yenangyaung, Chauk, and Lanywa. Conditions in the neighborhood continued extremely disturbed, fighting taking place between the government troops ano the insurgents, especially around Yenangyaung, and in July it became necessary for the oil companies to withdraw their British staff from Yenangyaung and to close down their operations in this field. Later in the year the Government lost control of the small oilfields near Minbu, and at no time during the year has work been possible at Yenangyat. Operations in the main Chauk and Lanywa Fields have been severely handicapped by the activities of thieves and bandits, looting of material of all kinds being persistent. Attempts have been made to steal oil from reconditioned wells by flooding them with water, and in order to protect the oilsands many wells have been plugged with cement. The production of oil during the year was about 300,000 U.S. bbl, mainly from Chauk but with small contributions from the other fields.

Although a little geological mapping was undertaken in 1948 the deterioration of conditions made it impossible to carry out any exploration work in 1949. Even between Rangoon and the oilfields there were no surface communications, contact being only by airplane.

INDIA

The only producing oil field in India is the Assam Oil Company's field at Digboi in the north-east of Assam where development has continued normally during the year with concentration on the eastern extension of the field. Production has remained at about the same level as in the three previous years, being estimated at 1,950,000 U.S. bbl.

Exploratory drilling by the Assam Oil Co. in an area some ten miles south of Digboi was discontinued as no commercial production could be found. The Burmah Oil Co. (India Concessions) Ltd. completed a well in the Tiru Hills some 90 miles south-west of Digboi, but without success. At the end of the year material was being transferred to a neighboring area.

Geophysical work has continued in Upper Assam and geological mapping has been in progress in several parts of Assam. No new areas of promise have been found.

The rules governing the grant of petroleum concessions have been revised; the approval of the Central Government is now required before the grant of concessions by a Provincial Government, greater recognition is given to the length of time which may be needed for thorough exploration, and there have been increases in royalty and other payments.

PAKISTAN

During the year production has continued from the Attock Oil Company's Khaur, Dhulian, Joya Mair, and Balkassar Fields, and the Burmah Oil Company (Pakistan Concessions) Ltd. have also begun production from Balkassar. The total output increased from 560,000 U.S. bbl in 1948 to 940,000 U.S. bbl in 1949. The Attock Oil Co. completed their Balkassar No. 5 and No.6 and the Burmah Oil Co. (Pakistan Concessions) their Chakwal No. 2. These wells are drilled through the limestone using oil as circulating fluid, and are then given successive treatments with inhibited hydrochloric acid.

The Attock Oil Co. continued exploratory drilling on the Meyal structure north-west of Dhulian, and the Burmah Oil Co. (Pakistan Concessions) carried down their Lakhra test well (situated 100 miles north-east of Karachi) from 4,800 ft to almost 12,000 ft during the year without finding any indications of oil. Geological work was continued in West Pakistan by the Attock Oil Co. and in both West and East Pakistan by the Burmah Oil Co. In the early part of the year aseismic reflection survey in the neighborhood of the Balkassar Field was completed.

The old petroleum concessions rules have been superseded by new rules based in some respects on the British Colonial model: concessions are granted only to nationals of Pakistan or to companies incorporated in Pakistan; royalties andother fees are increased and concessionaires must undertake to spend more than a stipulated minimum annual amount on exploration.

Oil And Gas Developments In Brazil During 1949

From the production viewpoint alone, progress has been slight during the past year in Brazil. The total production was a little less than 110,000 bbl. However, at least 1,000,000 bbl could have been produced if refining facilities had been available. At the present time a refinery of 2,500 bbl daily capacity is being constructed in Bahia and is expected to be in operation by October 1950 so 1951 should see a considerable rise in the annual production figures and be more representative of the true productive potential of Brazil.

In the exploration field considerable progress was realized during 1949. Both geophysical and geological work was expanded and reconnaissance work was being undertaken in the Parana Basin, the Reconcavo in Bahia, the Northeast Coastal Area, the Maranhao-Piaui Basin, the Marajo Basin and in the Middle Amazon Region. Action had been taken to begin wildcat operations in Sergipe, Maranhao and the Marajo Basin. 1949 has been an important year of progress for the exploration of oil in Brazil.

Products of National Refineries in 1949

	Bbl (U.S.)
Gasoline	149,359
Diesel Oil	140,183
Fuel Oil	127,439
Kerosene	49,052
Asphalt Material	22,229
Solvents Material	14,389
Solvents (Naptha)	8,249
Gasoline Solvent	5,696
Lubes - Oil Material	4,365
Lube Oils	2,297
Bottoms	2,446
Totals	525,704

IMPORTS OF PETROLEUM AND ITS DERIVATIVES DURING 1949

COUNTRY OF ORIGIN	GASOLINE	AVIATION GASOLINE	KEROSENE	DIESEL AND GAS OILS	FUEL OIL	LUBRICATING OIL	CRUDE OIL	TOTALS
Indonesia	7,590,774	622,403	1,288,378	2,414,228	5,870,045	24,786		17,810,484
United States	735,097	44,108	46,842	60,760	26,881	516,732		1,430,420
Trinidad	1,099,497	150,214	154,947	435,821	818,683			2,659,162
Venezuela	13,167			224,244	2,852,830		455,262	3,545,494
Mexico	5,410							5,410
Peru			1,324	3,988				5,312
England						686		686
Total	9,443,746	816,745	1,491,490	3,139,091	9,568,429	542,304	455,262	25,456,969
In U. S. Bbl								

DATA ON IMPORTS OF PETROLEUM AND ITS DERIVATIVES BY NATIONAL PORTS

PORTS	GASOLINE	AVIATION GASOLINE	KEROSENE	DIESEL AND GAS OILS	FUEL OIL	LUBRICATING OIL	CRUDE OIL	TOTALS
Manus				3,988		393		4,381
Belem	124,124	66,051	100,184	117,880	115,184	13,250		531,674
Sao Luis						1,073		1,073
Parnaiba						316		316
Fortaleza	80,493	6,699	40,215			5,242		132,649
Natal	63,749	40,221		5,256	30,367	787		140,379
Cabedelo						69		69
Joao Pessoa						1,767		1,767
Recife	515,053	83,620	260,371	289,083	1,389,121	19,802		2,557,050
Maceio						1,065		1,065
Salvador	256,668	38,902	118,340	108,155	235,317	12,242		708,724
Vitoria						275		275
Rio de Janeiro	3,014,146	410,691	477,256	1,324,120	3,035,148	301,276		8,565,685
Santos	4,247,048	145,969	569,914	1,106,756	4,394,415	148,832	150,073	10,563,006
Paranagua	147,316			7,336	27,103	5,497		187,252
Itajai						3,856		3,856
Sao Francisco						52		52
Florianopolis						4		4
Porto Alegre						18,766		18,766
Rio Grande	963,149	25,493	125,169	181,510	807,539	7,642	305,189	1,917,690
Livramento					31,236			31,236
Totals	9,443,746	816,745	1,491,490	3,139,091	9,568,429	542,304	455,262	25,456,969
In U. S. Bbl								

TABLE I - OIL AND GAS PRODUCTION STATISTICS IN BRAZIL DURING 1949

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl	
				AREA PROVED ACRES	BARRELS		AREA PROVED ACRES	MILLION CU FT[c]				
					TO END OF 1949	DURING 1949		TO END OF 1949	DURING 1949		TO END OF 1949	DURING 1949
1	Aratu	Island (Cre U)	1942	20	56,140	1,598	0	0	0	x	x	x
2		Island (Cre U)					1,200	586	73.0	x	x	x
3	Candeias	Santo Amaro (Cre) (Production is from lenticular sand found in Candeias shale member)	1941	1,000	441,601	97,553	x	17	1.5	x	x	x
4	Dias Joao	Santo Amaro Zone 'A'	1942	x	0		0	0	0	x	0	0
5		(Cre) Zone 'B'	1947	x	0		0	0	0	x	0	0
6		Brotas (Cre L?) Zone 'C'	1947	1,100	16,884	6,468	0	0	0	x	0	0
7		(Sergi S.S.) Zone 'D'	1947	650	0		0	0	0	x	0	0
8		Zone 'E'	1947	300	0		0	0	0	x	0	0
9		Zone 'F'	1947	250	0		0	0	0	x	0	0
10		Zone 'G'	1947	150	0		0	0	0	x	0	0
11		Zone 'H'	1947	x	0		0	0	0	x	0	0
12	Itaparica	Santo Amaro (Cre)	1942	300	52,421	0		310	4.5	x	x	x
13		(Brotas (Cre L?)										
14		(Sergi S.S.)										
15	Lobato-Joanes	Island (Cre U)	1939	150	71,469	3,453		8	0.5	x	0	0

LINE NUMBER	NUMBER OF WELLS[e]			WELLS PRODUCING[f] DEC. 1949			RESERVOIR PRESSURE LB. PER SQ. INCH		SECONDARY RECOVERY[g]	CHARACTER OF OIL[h]		PRODUCING FORMATION					DEEPEST ZONE TESTED[n] TO END OF 1949	
	COMPLETED TO END 1949	1949		OIL		GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT.[k]	PROD. THICKNESS AVG. FT. NET	STRUCTURE[m]	NAME	DEPTH OF HOLE, FT.
		COMPLETED	ABANDONED	FLOWING	ARTIFICIAL LIFT													
1	6	0	0	0	2	0	x	x		46	x	S	16	1,550	50	D	Drilled Crystalline	5,824
2	5	0	0	0	3	0	1,025	x		28	x	S	17	1,950	65	A	Brotas (Serga S.S.)	5,587
3	53	8	0	14	38	1	x	x				S	18	2,900				
4							x	x		38	x	S	24	300	50	A F	Brotas (Alagoas Shale)	2,896
5							x	x		38		S	21	550	20			
6	15	5	0	0	15	0	x	x		38		S	21	700	20			
7							x	x		38		S	21	850	10			
8							x	x		38		S	21	900	20			
9							x	x		38		S	21	950	15			
10							x	x		38		S	21	1,050	30			
11							x	x		38		S	21	1,100	x			
12	21	0	0	8	8	5	x	x		30	x	S		2,000	30	A	Drilled Crystalline	6,250
13																		
14																		
15	7	0	3	0		0	x	x		32	x	S		2,000	60	M F	Drilled Crystalline	7,385

TABLE 2 - SUMMARY OF DRILLING OPERATIONS IN BRAZIL BY DR. AVELINO OLIVEIRA *

LINE NUMBER	COUNTY OR LOCALITY	LOCATION SEC.	LOCATION TWP.	LOCATION RGE.	TOTAL DEPTH, METERS	FORMATION	DEEPEST HORIZON TESTED	DRILLED BY	INITIAL PRODUCTION PER DAY OIL, U.S. BBL.	INITIAL PRODUCTION PER DAY GAS, MILLIONS CU. FT.	INITIAL PRODUCTION PER DAY CONDENSATE U.S. BBL.	CHOKE FRACTIONS OF AN INCH	PRESSURE, LB. PER SQ. IN. CASING	PRESSURE, LB. PER SQ. IN. TUBING	REMARKS
	IMPORTANT WILDCATS DRILLED IN 1949														
		SURVEY	LAT.	LONG											
1	Laranjeiras No. 1, State of Sergipe	Approx.	10°48'S	37°18'W	1,312	Laranjeiras (Cretaceous)	To Crystalline	Itatig Co.							Dry hole W/few oil shows
2	Bestinga No. 1 Reconcavo, Bahia	Approx.	12°48'S	38°29'W	2,900 Holds Brazil depth record	Island (L. Cretaceous)	Sergi Sand (Lower Cretaceous)	Conselho Nacional do Petroleo		4,000 (Estim)		5/8			Production tests showed well to be sub-commercial
3	Tucano ML-1, No. Bahia	Approx.	11°01'S	38°48'W	1,862	Cicero Dantes	Tucano Shales	Conselho Nacional do Petroleo							Dry hole No oil shows

* Vice-President and Director of Technical Division Conselho Nacional do Petroleo

Oil And Gas Developments In The Netherlands During 1949

By A. A. G. SCHIEFERDECKER

SCHOONEBEEK FIELD

The drilling activity in 1949 was concentrated in two separate offset areas, one towards W. in the S. flank of the structure along the German border and the other on the border in the E. part of the concession where in the W. tip of the German Ruhlertwist-Ruhlermoor structure production was found on Dutch territory.

In total 18 producers were completed. The proved area having thus been somewhat extended it was possible to withdraw oil at a higher rate toward the end of the year. The daily average production of 11,823 bbl reached in 1949 covers about 25 per cent of the country's consumption.

EXPLORATION

The Nederlandse Aardolie Maatschappij continued its widespread exploration program in the Netherlands. Based on geophysical information a total of 16 exploration wells were drilled during 1949. In one of these wells gas in commercial quantities was discovered near De Wijk, 25 miles west of Schoonebeek.

Toward the end of the year a heavy drilling outfit started operating in the Coevorden area to develop the Permian gas field discovered in 1948.

MANUSCRIPT RECEIVED IN THE OFFICE OF THE INSTITUTE, APRIL, 1950.

TABLE I - OIL AND GAS PRODUCTION STATISTICS FOR THE NETHERLANDS

FIELD	YEAR OF DISCOVERY	OIL PRODUCTION THOUSANDS OF BBL		NUMBER OF WELLS COMPLETED	1949		WELLS PRODUCING DECEMBER 1949 OIL		GRAVITY	PRODUCING FORMATION
		TO END OF 1949	DURING 1949	TO END OF 1949	COMPL.	ABD.	FLOWING	ART. LIFT		
Schoonebeek	1943	9,727	4,316	104	20			94	24.8	2,500'

Oil And Gas Developments In Canada During 1949

By GEOLOGICAL SURVEY OF CANADA, Ottawa, Ontario, Canada

ABSTRACT

Alberta's 1949 oil production nearly doubled that of 1948, reaching about 20,300,000 bbl as compared with 10,974,000 bbl for 1948. It is estimated that over 800 wells were drilled in Alberta to give a footage of over 3,000,000 ft. Reserves are estimated to have increased to at least a billion bbl.

The greatest expansion was made in the Redwater Field where 289 wells were drilled during the year to outline the largest producing field in Alberta. Development and expansion of the Leduc-Woodbend Field continued with extensions to the southwest.

Of the new discoveries that at Golden Spike is the most outstanding. The discovery well drilled 544 ft of oil saturated pay in the D3 zone of the Devonian and was completed with a rated capacity of 10,000 B/D. Another important Devonian discovery was the Imperial Normandville well in the Peace River District, 200 miles northwest of Edmonton. Although not a big well, it opens up possibilities of appreciable Devonian reserves in the northwest of Alberta.

A number of other important discoveries was made in Alberta. Among these are the discoveries at Stettler where conditions similar to Leduc were found; at Bon Accord and Excelsior where Devonian oil was discovered; at Barrhead where two wells produce from the Mississippian--and at Joseph Lake, Whitemud, Campbell and Volmer which produce from sands of Cretaceous age.

The search has extended from Alberta into Saskatchewan, Manitoba and northeastern British Columbia. Large exploratory programs have been carried on in Saskatchewan but no drilling has been done except in areas contiguous to the Lloydminster Field. Two unsuccessful wells were drilled in Manitoba and two are now drilling in northeastern British Columbia.

A pipe line to carry oil from Edmonton to Superior, Wisconsin, is now under construction.

In the east, exploration has continued in New Brunswick where two exploratory tests have been drilled and in Gaspe where four wells are in progress.

Production of oil in Ontario during 1949 showed a substantial increase of about 90,000 bbl over that of the previous year to bring the total recovery to about 265,000 bbl. Most of this increase is due to further extension of the Becher West Field (Salina-Guelph formation) discovered in 1946 by Imperial Oil Limited.

Although several new gas wells were drilled in the southwestern part of the Province and small new volumes are still being found in the older Haldimand and Welland Fields, the total production of gas for the year shows a small decline from that of 1948.

Wildcat drilling took place chiefly in Kent and Lambton Counties. The most important single gas well was drilled by Imperial Oil Limited in Moore Township near Sarnia. This well obtained an initial open flow of about 40 Mlcf to become the largest well so far drilled in Ontario.

Large new gas reserves have been discovered in Alberta incidental to the search for oil. In the Pincher Creek area the Canadian Gulf Walter Marr well had a calculated gas flow of 83 Mlcf a day and a distillate yield rated at 3,000 bbl a day. A large number of wells in the area north of Edmonton, at Hanna, Castor, Lac La Biche and other places rated from 20 to 30 Mlcf a day.

PETROLEUM

New records were set in all phases of the oil industry in Canada during the past year, most of these being made in the province of Alberta.

Production in Alberta amounted to 20,246,466 bbl in comparison with 10,973,583 bbl for 1948 and 6,809,284 bbl for 1947. Revenue derived from the sale of oil and natural gasoline was $58,999,936 as compared with $34,391,528 in 1948. At the end of 1949 there were 1,219 wells capable of production in Alberta of which 1,013 were operated in December. Seven hundred and eighty-four wells completed drilling during the year.

These oil developments in Alberta are of great importance to the economy of Canada as a whole. Canada consumes some 110,000,000 bbl of oil annually of which in 1949 she produced 21,487,130 bbl or about 20 per cent. The importance of the developments in Alberta is obvious when it is considered that in 1947, the year the Leduc Field was discovered, production amounted to only 7,632,204 bbl, less than 10 per cent of Canada's requirements at that time.

The western provinces are now self sufficient with regard to oil, and production from Alberta Fields has been curtailed under a system of strict pro-rationing because of the inadequacy of present prairie refinery capacity and the high cost of rail transportation which prohibits the movement of oil to outside markets. Although during the last few months of 1949 production averaged only about 60,000 B/D, it is estimated that the Alberta Fields have a potential of 125,000 B/D.

In order to provide new markets for the surplus oil the Interprovincial Pipe Line Company Limited is building a pipe line from Edmonton to Regina and thence to Gretna, Manitoba, from which the line will pass through the United States to the head of the Great Lakes at Superior, Wisconsin. The cost is estimated at about $90,000,000. The first 450 miles of the line from Edmonton to Regina is expected to be in operation by the fall of 1950 and will have an initial capacity of 95,000 B/D. Completion of the line to Superior, Wisconsin is expected in 1951. It is estimated that 57,000 B/D will be shipped by tanker from Superior to eastern Canadian refineries.

This surplus oil production has also necessitated a large increase in refinery capacity, especially in the Prairie Provinces. It is estimated that refinery capacity has increased about 11 per cent during the past year. A number of units are under construction at the present time and plans have been made for the construction of several new refineries.

LEDUC-WOODBEND FIELD - The Leduc Field, the discovery of which precipitated the search for oil in the Devonian of the Alberta plains, has been developed steadily during the past year. Production from the Leduc Field amounted to 9,688,784 bbl, as compared with 4,657,371 bbl in 1948.

Developments in this field during the past year include an extension of the D2 producing zone to the southwest of previous production and the establishment of a corridor connecting the D3 reef zones at Leduc and Woodbend. Construction was started on a compressor and processing plant to use the gas produced with the crude.

REDWATER FIELD - The Redwater Field to the northeast of Edmonton which had only three wells producing at the beginning of the year has shown the greatest development. It now covers 14,000 acres and produces under strict proration at the rate of 21,000 B/D from a reef limestone of Devonian age equivalent to the D3 dolomite at Leduc. The field covers an area about 14 miles long by 4 miles wide at the present time but has not yet been entirely delimited. Late in the year a wildcat, Imperial Simmons No. 1 drilled about 3 miles southeast of previous production, discovered oil in D3 reef limestone. The oil-water interface is the same as that at Redwater and it is probable that this forms a further extension of the Redwater Field.

OLDER FIELDS - In most of the older fields production has fallen off and because of the local surplus of crude there has been little incentive to drill new wells. Turner Valley production decreased from 4,900,739 bbl in 1948 to 4,304,063 bbl. Total production from Taber, Vermilion, Conrad, Wainwright and Princess inclusive decreased from 700,328 to 494,720 bbl.

LLOYDMINSTER - Production of heavy crude from the Lloydminster and adjoining areas in both Alberta and Saskatchewan has been adversely affected by the surplus of heavy ends from the light crude fields which have seriously cut into the heavy crude markets. At times during the year production at Lloydminster was reduced to 30 per cent of potential. The rate of expansion of the field was slowed down as shown by an increase of only 100,000 bbl in 1949 over 1948 production. New refinery units which plan to put out a larger range of products are now under construction in Lloydminster and Calgary and may be expected to create a larger market for the oil.

NEW FIELDS - Exploratory wells resulted in the discovery of several new fields. One of the most important was the Imperial Golden Spike discovery six miles west of the Woodbend Field. The discovery well penetrated a 544 ft section of oil producing reef limestone in the D3 zone of the Devonian. Initial potential of the discovery well was rated at 10,000 B/D. The second well to find production, drilled late in 1949, found a 594 ft section of reef of which 560 ft produced oil. In this well production was also indicated in the D2 zone.

Another Devonian reef discovery was made in the Stettler area. The discovery well, Canadian Gulf Oil Company's N. J. Ellis No. 4 well, found production in both the D2 and D3 zones of the Devonian which have a combined thickness of 100 ft. The well on test had a rated capacity of 3,000 bbl.

Another important discovery was the Imperial Normandville No. 1 well in the Peace River district about 200 mi northwest of Edmonton. This well obtained production from the Devonian at 6,730 ft. Although not a big well it has great significance in that it opens up possibilities of oil production from the Devonian in the Peace River area and far to the north.

In addition to the above a number of other important discoveries were made during the year. The more important finds include:

A Devonian D2 zone discovery at Bon Accord about 18 miles north of Edmonton. The discovery well made 165 bbl of oil in 4½ hours on production test.

Another D2 Devonian discovery was made in November at Excelsior 12 miles north of Edmonton. On test the discovery well flowed at the rate of 792 B/D from a 40 ft section. Two wells had been brought into production by the end of the year.

At Barrhead, 55 miles northwest of Edmonton, a discovery was made by Stanolind Oil and Gas in a pinch-out in the Mississippian. The discovery well flowed at the rate of 36 bbl per hour on test.

At Whitemud, six miles south of Edmonton, an important discovery was made in sands of Lower Cretaceous Age in April. The discovery well, Imperial Whitemud No. 1, flowed on test at the rate of 250 bbl a day.

At Joseph Lake, 18 miles southeast of Edmonton, a discovery of oil was made in the Viking sand of Cretaceous age. This sand is the equivalent of the producing sand in the large Viking-Kinsella-Fabyan gas field and of gas-producing sands elsewhere in central Alberta but Joseph Lake is the first discovery of oil in this sand. The initial well had a rated oil capacity of 528 B/D.

A number of other small oil discoveries were made in sands of Lower Cretaceous Age. These include a well at Volmer 15 miles northwest of Edmonton, one at Campbell 8 miles northwest of Edmonton which produced up to 50 B/D, and one at Casagama near Stettler.

GAS DISCOVERIES

Incidental to the search for oil in Alberta a large number of natural gas discoveries have been made during the year. The most important of these was the Canadian Gulf Walter Marr well about 7½ miles northwest of the Pincher Creek gas-distillate well discovered in 1948. The Walter Marr well had a calculated gas flow of 83 MMcf a day with a distillate yield of 3,000 bbl from limestones of Mississippian age. These two wells indicate an extremely large natural gas reserve in this area. Although some of the other natural gas discoveries in the Plains rated as much as 20 MMcf per day most of them have been capped and further development left until larger markets are available.

SASKATCHEWAN - The oil play has extended from Alberta into Saskatchewan during the past year. Although exploratory permits and leases have been granted to cover most of the southern part of the Province, exploratory work is still in the preliminary stages and as yet only a few stratigraphic tests have been drilled. However, a new heavy oil area similar to Lloydminster has been opened up near Maidstone east of Lloydminster.

BRITISH COLUMBIA - Interest in the oil possibilities of British Columbia and Manitoba has increased during the year. A test was drilled in the Queen Charlotte Islands of British Columbia and another, drilled late in the year in the Peace River area, had encouraging showings of gas in the Triassic.

MANITOBA - In Manitoba two wildcats were drilled but no production was obtained.

NORTHWEST TERRITORIES - In the Northwest Territories the Norman Wells Field is still operated for local requirements only, with production of about 200,000 bbl during the past year.

ONTARIO - About 362 wells were completed in Ontario during 1949 as compared with about 350 in 1948. Of the total number drilled, 280 were development wells, the remaining 82 consisting of exploratory drilling in search of new fields. Development drilling resulted in 15 oil wells, 150 gas wells and 115 dry holes. All but two of the oil wells are located in the Becher Field (Salina-Guelph formation: Silurian) and had an average initial yield of about 36 B/D. About 132 of the gas wells were completed in the old Haldimand-Welland Field in the Niagara Peninsula. These produce from sands of Silurian Age and had an average initial open flow of about 50 Mcf a day. Thirteen gas wells with average initial open flow of 240 Mcf a day were completed in the Mosald Field (Guelph formation: Silurian) in Elgin County discovered in 1948 by Union Gas Company of Canada Limited. Further drilling by Imperial Oil Limited in the Kimball Field near Sarnia resulted in about five wells with an average initial open flow of 4,000 Mcf a day. The most important single well, Imperial-Payne, located about 1½ miles northwest of Kimball Field had an initial open flow of 40,000 Mcf a day and is the largest gas well ever brought in in Ontario. Production is from reef formation in the Silurian.

COMPLETION SUMMARY - 1949

	GAS	OIL	DRY	TOTAL	SUCCESSFUL
Development wells	152	13	115	280	59%
Exploratory tests	5	-	77	82	6%

PRODUCTION

	1948	1949	CUMULATIVE TOTAL TO 12-31-49
Oil	176,225 Bbl	265,000 Bbl	30,675,000 Bbl
Gas	9,060,277 Mcf	9,418,000 Mcf	464,000,000 Mcf

IMPORTANT EXPLORATORY TESTS

WELL	LOCATION	T. D.	HORIZON TESTED	REMARKS
Breedon No 1	Adjala tp	975	Black Ft. fm. Ordovician	Oil shows and porosity betw. 854 - 949 ft
Misener No 1	Wainfleet tp.	3,104	Basal Beds, Ordovician-Cambrian ?	
W. Dawson No 6	Romney tp.	3,588	Basal Beds Ordovician-Cambrian ?	

QUEBEC - In the rest of Eastern Canada there have been no developments of importance. The search for oil has continued in Gaspe with three wells drilling during the year.

NEW BRUNSWICK - In New Brunswick the Stoney Creek Field produced some oil, and gas to supply the City of Moncton. Two wildcats were drilling at the end of the year.

ABSTRACT - OIL DEVELOPMENTS IN CANADA DURING 1949

FIELD	PRODUCING FORMATION	YR. OF DISC.	OIL PRODUCTION ESTIMATED PRODUCTION BBL TO END - 1949	DURING 1949	NO. WELLS END 1949	NO. WELLS DUR. 1949	GRAV. API	CHAR.	DEP. TOP PROD. ZONE FT	STRUCT
LEDUC										
Lower Cret.	Cre. L	1948			10	4	37-39	S	4,200	H
D2 Zone	Dev. U	1947	14,531,000	9,528,000	103	57	38-40	D	5,100	M C
D3 Zone	Dev. U	1947			242	120	38-40	D	5,300	M C
TURNER VALLEY								S		
Shallow Wells	Cre. L	1914								
Limestone Wells	Mis. U	1924	102,155,000	4,303,000	383	3	43	LS,D	3,150-9,150	A F
Redwater	Dev. U	1948	4,914,000	4,877,000	290	287	35	L	3,100	M C
Taber	Cre. L	1942	1,190,300	149,600	27	0	23	S	3,200	A M
Vermilion	Cre. L	1939	1,121,900	88,700	76	0	14-15	S	1,850	H
Wainwright	Cre. L	1923	290,500	16,900	21	0	18	S	2,250	H
Conrad	Ellis, Jur	1944	903,000	139,500	26	0	25	S	3,200	M C
LLOYDMINSTER										
Alberta	Cre. L	1939	1,758,000	690,000	142	23	14-17	S	1,920	H
Saskatchewan	Cre. L	1939	2,305,000	761,000	230	47	14-17	S	1,920	H
Princess	Mis. U (mainly)	1945					27	L	3,303	A
	Dev. U	1944	588,000	121,000	26	0	35	D	3,985	A
Pincher Creek	Mis U	1948	x	x	2	1	52	D	x	A f
Bantry	Cret. L	1947	29,425	13,729	1	0	24	S	3,250	A
Del Bonita	Mis. U	1943	x	x	6	0	38	L	5,035	A
Dina (Alberta)	Cre. L	1929	x	x	x	x	x	S	1,800	H
Golden Spike	Dev. U	1949	75,020	75,020	2	2	38-39	L	5,370	M C
Joseph Lake	Cre.	1949	35,858	35,858	4	4	37.2	S	3,250	H
Whitemud	Cre. L	1949	x	x	4	4		S	4,055	H
Stettler	Dev. U	1949	x	x	3	3	29.7	D	5,185	M C

* 1 Bbl equals 35 Imperial gallons

TABLE I - OIL AND GAS PRODUCTION IN ALBERTA, CANADA DURING 1949

LINE NUMBER	FIELD (County)[2]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl	
				AREA PROVED ACRES	BARRELS [1] TO END OF 1949	BARRELS [1] DURING 1949	AREA PROVED ACRES	MILLION CU FT[c] TO END OF 1949	MILLION CU FT[c] DURING 1949		TO END OF 1949	DURING 1949
1	Barrhead	Mis U	1948	x	4,223	4,223						
2	Bon Accord	Dev U Ⅱ	1949	x	9,676	9,676						
3	Campbell	Cre L	1949	x	4,685	4,685						
4	Conrad	Ellis Jur	1944	640	903,358	139,728						
5	Del Bonita - Twin River	Mis U	1943	80	53,035	7,365						
6	Dina	Cre L	1929	80	59,773	14,062						
7	Excelsior	Dev U	1949	x	1,436	1,436						
8	Golden Spike	Dev U	1949	x	85,081	85,081						
9	Joseph Lake	Cre	1949	x	35,858	35,858						
10	Jumping Pound	Mis U	1944	6,300	9,259	0						
11	Leduc											
12	Lower Cretaceous	Cre L	1948	x	240,578	202,643		137	106	0.424		
13	D 2 Zone	Dev U	1947	x	2,964,951	1,985,373		1,610	1,138	0.568		
14	D 3 Zone	Dev U	1947	13,000	11,580,053	7,500,768		5,651	4,071	0.542		
15	Lloydminster											
16	Alberta	Cre L	1939	x	1,786,565	716,941						
17	Saskatchewan	Cre L	1939	x								
18	Normandville	Dev U	1949	x	5,891	5,891						
19	Pincher Creek	Mis U	1948	x	4,560	2,319						
20	Princess				587,605	121,227						
21	Mississippian chiefly	Mis U	1945	x								
22	Devonian	Dev U	1944	x								
23	Redwater	Dev U	1948	14,000	4,830,366	4,793,491		677	671	0.14		
24	Stettler				15,725	15,725						
25	D 2 Zone	Dev U	1949	x								
26	D 3 Zone	Dev U	1949	x								
27	Taber				1,191,644	150,746						
28	East	Cre L	1942	280								
29	West	Cre L	1944	360								
30	Turner Valley				101,645,058	4,304,063						
31	Shallow Zone	Cre L	1914		512,110	1,198						
32	Limestone	Mis U	1924	12,000	101,166,340	3,825,345	12,000	1,487,711	35,035	8.1		
33	Vermilion	Cre L		x	1,177,719	86,933						
34	Volmer	Cre L	1949	x	1,048	1,027						
35	Wainwright	Cre L	1923	200	289,681	16,086						
36	Whitemud	Cre L	1949	x	26,506	26,506						

(1) 1 Bbl equals 35 Imperial Gallons
(2) Wild well, Atlantic 3, abandoned 1948.
(3) Gas supply wells from Viking zone.

LINE NUMBER	NUMBER OF WELLS[c]			WELLS PRODUCING[f] DEC. 1949			RESERVOIR PRESSURE LB. PER SQ. INCH		SECONDARY RECOVERY[g]	CHARACTER OF OIL[h]		PRODUCING FORMATION					DEEPEST ZONE TESTED[n] TO END OF 1949	
	COMPLETED TO END 1949	1949		OIL		GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT.[k]	PROD. THICKNESS AVG. FT.[l] NET	STRUCTURE[m]	NAME	DEPTH OF HOLE, FT.
		COMPLETED	ABANDONED	FLOWING	ARTIFICIAL LIFT													
1	2	1	0	1		0	x			23	x	D	x	3,970	x	x	Dev.	6,414
2	1	1	0	1		0	x			x		D	x	3,580	x	M C	Dev	4,630
3	1	1	0		1	0	x			35		S	x	3,705	x	H	Dev	5,000
4	26	0	x		16	x	x			26		S	x	3,200	x	M C	Mis U	3,280
5	6	0	x		1	x	x			38		L	x	5,040	x	A	Mis U	5,035
6	10	0	x		2	x	x			x		L	x	1,800	x	H	Dev U	3,200
7	1	1	0	1	0	0	x			36		D	x	3,830	x	M C	Dev U	4,125
8	2	2	0	2	0	0	x			38		L	x	5,363	544	M C	Dev U	6,082
9	4	4	0	0	4	0	x			35		S	x	3,270	x	H	Dev	5,215
10	2	0	0	0	0	0	x			x		L	10-12	10,000	147	A F	Can	14,443
11																		
12	10	5	0		9	0	x			37, 5-40		S	x	4,300	x	A		
13	108	67	0	103		0	1,770			38-40		D	13	5,800	40	M C		
14	234	107	1[2]	229		0	1,894			38-40		D	13	5,800	40	M C	Dev	7,007
15																		
16	145	26	x		78	10	x			14-17	3.05-3.95	S	x	1,900	x	H	Dev	3,414
17	232	49	x		96	14	x			14-17	3.05-3.95	S	x	1,920	x	H	Dev	2,894
18	1	1	0	1	0	0	x			37		x	x	6,730	x		Pre-Cam	7,424
19	2	1	0	0		0	x			32		L	x	11,755	400	A F	Mis U	12,768
20					12													
21	14	0	x		7	0	x			26-28		L	x	3,300	x	A	Dev U	4,300
22	12	0	x		5		1,470			12.5-35		D	x	3,985	x	A	Can	6,155
23	290	287	0	295		3[3]	x			34		L	x	3,300	x	M C	Dev U	4,476
24																		
25	1	1	0	1			x			30		D	x	5,200	x	M C	Dev	5,440
26	1	1	0	1			1,725			28		D	x	5,300	50	M C	Dev	5,440
27	21	0	x		19													
28					2		x			18-19	2.1	S	20	3,300	x	A M	Mis U	3,250
29					12		x			23		S	x	3,200	x	A M	Dev U	4,725
30																		
31	x	0	x		1		x			x	x	S	x					
32	383	3	x	276		41	2,785			43-56		L S R	10-12	3,450-9,150	180	A F	Banff Mis L	8,978
33	54	0	x		24		570			14	3.3	D						
34	1	1	0	0	1		x					S	x	1,850	8	H	Can	4,630
35	23	2	x		3		x			14-18		S	x	3,670	x	H	Can	7,272
36	4	4	0	3			x			38	x	S	x	2,250	thin	H	Can	4,650
														4,055	x	H	Dev	6,258

TABLE 2 - SUMMARY OF DRILLING OPERATIONS IN ALBERTA, CANADA

IMPORTANT WILDCATS DRILLED IN 1949

LINE NUMBER	COUNTY OR LOCALITY	LOCATION SEC. SURVEY	TWP. LAT.	RGE. LONG.	TOTAL DEPTH, FT.	SURFACE FORMATION	DEEPEST HORIZON TESTED	DRILLED BY	REMARKS
									* Equals 35 Imperial Gals.
1	Stony North Branch	3	2	19W4	4,249	Oldman	Devonian	Stony-Vacuum Explor. Co.	Dry Hole
2	Walter Marr #1	29	4	29W4	12,768	Wapiabi	Mississippian	Canadian Gulf Oil Co.	Gas well-(Distal.
3	Winnifred #1	6	12	9 W4	4,800	Oldman	Devonian	Hudson's Bay Oil & Gas Co.	Dry Hole
4	Winnifred #2	3	10	10 W4	3,245	Oldman	Mississippian	Hudson's Bay Oil & Gas Co.	Dry Hole
5	Scott #1	6	16	12 W4	4,262	Oldman	Devonian	Westates Petroleum Corp.	Dry Hole
6	H. B. S. Wilson #1	6	17	25 W4	8,510	Paskapoo	Devonian	Burnsdall Oil Co.	Dry Hole
7	Anglo Canadian Black Diamond #1	12	20	2 W5	9,309	Paskapoo	Mississippian	Anglo Canadian Oil Co.	Dry Hole
8	Royalite Crowfoot #3	9	20	19 W4	6,462	Bear Paw	Devonian	Royalite Oil Co., Ltd.	Dry Hole
9	Acadia	9	21	7 W4	3,419	Belly River	Mississippian	Hudson's Bay Oil & Gas Co.	Dry Hole
10	Royalite Priddis #1	30	22	3 W5	10,196	Belly River	Mississippian	Royalite Oil Co., Ltd.	Dry Hole
11	Sun Langdon C. P. R. #1	3	23	27 W4	8,800	Paskapoo		Sun Oil Co.	Dry Hole
12	Redwater Leaseholds-Globe Hall. #1	7	28	12 W4	4,003	Bear Paw		Redwater Leaseholds-Globe Oil (Joint Venture)	Dry Hole
13	Stony Verdant Valley #1	14	29	18 W4	5,552	Edmonton	Devonian	Stony-Vacuum Explor. Co.	Dry Hole
14	Hudson's Bay Sparky #1	12	29	5 W4	4,046	Bear Paw	Devonian	Hudson's Bay Oil & Gas Co.	Gas Well
15	Strathford #1	17	29	13 W4	5,002	Edmonton		Strathford Petroleums, Ltd.	Dry Hole
16	Amerada Stanolind-Crown BF 21 A-23	23	26	14 W4	5,232	Bear Paw	Devonian	Amerada Petroleum Corp.	Gas Well
17	Oyen Wheat King #1	3	27	5 W4	3,715	Bear Paw		Oyen Syndicate	Dry Hole
18	Brook Stanmore #1	22	30	11 W4	5,210	Bear Paw		British Dominion Oil & Dev.Corp.	Dry Hole
19	South Brazeau Petroleum #4	36	31	14 W4	4,646	Edmonton		South Brazeau Petroleum	Gas Well
20	Redwater Leaseholds-Warner #1	6	32	14 W4	3,866	Edmonton	Mississippian	Redwater Leaseholds	Dry Hole
21	Hanna Syndicate #4	22	32	15 W4	5,066	Edmonton	Devonian	Hanna Petroleums, Ltd.	Dry Hole
22	Stony Craigmyle #1	32	32	16 W4	6,807	Edmonton	Cambrian	Stony-Vacuum Explor. Co.	Dry Hole
23	Stony Morrin #1	9	32	19 W4	6,436	Edmonton	Devonian	Stony-Vacuum Explor. Co.	Dry Hole
24	Western Prairie Stony Finding #1	16	34	15 W4	5,505	Edmonton		Western Prairie Explor. Co.	Dry Hole
25	Royalite Conort #1	2	34	6 W4	5,673	Bear Paw	Devonian	Royalite Oil Co.	Dry Hole
26	G. E. Upton #1	11	34	21 W4	6,610	Edmonton	Devonian	Canadian Gulf Oil Corp.	Dry Hole
27	Pacific Western Sullivan Lake #1	7	35	13 W4	4,523	Edmonton		Pacific Petroleums, Ltd.	Dry Hole
28	Sun Coronation Province #1	11	37	11 W4	3,994	Bear Paw	Devonian	Sun Oil Co., Ltd.	Gas Well
29	Bailey Michel Castor #1	5	38	14 W4	4,700	Edmonton	Devonian	Northern Development, Ltd.	Gas Well
30	British Empire Stettler #1	22	38	20 W4	5,403	Edmonton	Devonian	Northern Development, Ltd.	Oil Well
31	N. J. Ellis #4	10	38	20 W4	5,385	Edmonton	Devonian	Western Canadian Gulf Oil Co.	Oil Well
32	Piccadilly Inter Leduc Edwards #1	14	38	21 W4	5,723	Edmonton	Devonian	Piccadilly Inter Leduc Oils	Gas Well
33	Pearson #1	12	38	22 W4	6,700	Edmonton	Devonian	Western Canadian Gulf Oil Co. & British-American Oil Co.	Dry Hole
34	Canagema Stettler #1	7	39	19 W4	5,505	Edmonton	Devonian	Canagema Oil Co., Ltd.	Oil Well
35	Lacombe Province #65-10-40	10	40	27 W4	8,005	Paskapoo	Devonian	California Standard Oil Co.	Dry Hole
36	En Jay South Brazeau #2	29	42	21 W4	5,284	Edmonton		Enjay Petroleums, Ltd.	Dry Hole
37	Texaco-McColl Spotted Creek #2	35	42	23 W4	6,550	Paskapoo	Devonian	Texaco Exploration Co.	Dry Hole
38	Petromine Fabstone #1	31	43	2 W4	3,805	Birch Lake		Petromine Exploration Co.	Dry Hole
39	Pacific Sunray Hardisty #1	32	43	10 W4	3,480	Belly River	Devonian	Pacific Petroleums, Ltd.	Dry Hole
40	Royalite Texaco Sampson #1	5	44	23 W4	6,439	Edmonton	Devonian	Royalite Oil Co., Ltd.	Dry Hole
41	Jarrow #1	20	45	10 W4	4,250	Belly River	Devonian	Tower Petroleums	Gas Well
42	Imperial Irma #1	14	46	9 W4	6,752	Belly River	Pre-Cambrian	Imperial Oil Co., Ltd.	Gas Well
43	Royalite Texaco Sharphead #1	18	46	25 W4	6,850	Paskapoo	Devonian	Royalite-Texaco (Joint Venture)	Dry Hole
44	Imperial Pigeon Lake #1	36	47	3 W5	8,408	Paskapoo	Devonian	Imperial Oil Co., Ltd.	Dry Hole
45	Royalite Bosecan #1	14	47	18 W4	4,775	Edmonton	Devonian	Royalite Oil Co., Ltd.	Dry Hole
46	Sun Pipestone Creek Province #1	11	47	24 W4	6,257	Edmonton	Devonian	Sun Oil Co., Ltd.	Dry Hole
47	Pan Western Kavanaugh #1	16	48	24 W4	5,750	Edmonton	Devonian	Pan Western Oil, Ltd.	Dry Hole
48	Imperial Tofton #1	10	49	26 W4	6,373	Edmonton	Devonian	Imperial Oil Co., Ltd.	Dry Hole
49	Central Del Rio #1	26	50	1 W5	6,500	Edmonton	Devonian	Central Leduc Oils	Dry Hole
50	Texaco-McColl Tellordville #1	11	50	2 W5	5,345	Edmonton	Devonian	Texaco Exploration Co.	Dry Hole
51	Texaco Superior Banfurly #1	32	50	12 W4	4,225	Belly River	Devonian	Texaco Exploration Co.	Gas Well
52	Leduc Calmar Oliver Lake #1	15	50	21 W4	5,305	Edmonton	Devonian	Leduc Calmar Oil Co.	Gas Well
53	Superior Joseph Lake #1	22	50	22 W4	5,215	Edmonton	Devonian	Superior Oils, Ltd. 69 Bbl*10/64"	Oil Well
54	Bailey Nisku #1	12	50	25 W4	6,001	Edmonton	Devonian	A. G. Bailey, Ltd.	Dry Hole
55	Mercury Leduc #1	35	50	25 W4	5,470	Edmonton	Devonian	Mercury Oils, Ltd.	Dry Hole
56	Long Island Birch Lake #1	30	51	10 W4	3,234	Belly River	Devonian	Long Island Petroleums	Dry Hole
57	Redwater Petroleums #2	29	51	19 W4	4,936	Edmonton	Devonian	Redwater Petroleums, Ltd.	Dry Hole
58	Calmont Leduc #3	14	51	21 W4	5,305	Edmonton	Devonian	Calmont Leduc Oil, Ltd.	Dry Hole
59	Stony Vacuum Vegreville No. 1	30	51	15 W4	3,881	Belly River	Devonian	Stony Vacuum Explor. Co.	Dry Hole
60	Mutual Oil #1	25	51	24 W4	5,311	Edmonton	Devonian	Mutual Oil Co., Ltd.	Dry Hole
61	Imperial Whitemud #1	14	51	25 W4	6,258	Edmonton	Devonian	Imperial Oil Co., Ltd. 250 Bbl*	Oil Well
62	Imperial Golden Spike #1	22	51	27 W4	6,082	Edmonton	Devonian	Imperial Oil Co., Ltd. 10,000 Bbl*	Oil Well
63	Pan Western Edmonton #1	21	52	25 W4	5,603	Edmonton	Devonian	Pan Western Oils, Ltd.	Dry Hole
64	Royalite Stony Plain #1	12	52	26 W4	5,385	Edmonton	Devonian	Royalite Oil Co.	Dry Hole
65	Spruce Grove-Midland Petroleums #1	23	52	27 W4	6,050	Edmonton	Devonian	Midland Petroleums, Ltd.	Dry Hole
66	Imperial Plain Lake #1	11	53	12 W4	6,437	Belly River		Imperial Oil Co., Ltd.	Dry Hole
67	Midland Texaco McColl #1	11	53	1 W5	6,451	Edmonton	Devonian	Midland Petroleums	Dry Hole
68	Superior Fallis #1	36	53	5 W5	6,784	Edmonton	Devonian	Superior Oils, Ltd.	Dry Hole
69	Spruce Grove #1	11	53	27 W4	6,214	Edmonton	Devonian		Dry Hole
70	Texaco McColl Isle Lake #1	30	54	5 W5	6,707	Edmonton	Devonian	Texaco Exploration Co.	Dry Hole
71	Pacific Western Evansburg #1	31	54	7 W5	7,300	Edmonton	Devonian	Pacific Western Oil Co.	Dry Hole
72	Imperial Greenlach	16	54	21 W4	4,624	Edmonton	Devonian	Imperial Oil Co., Ltd.	Dry Hole
73	Imperial Ravenhead #1	22	54	23 W4	6,221	Edmonton	Devonian	Imperial Oil Co., Ltd.	Dry Hole
74	Imperial Namao #1	22	54	24 W4	5,188	Edmonton	Devonian	Imperial Oil Co., Ltd.	Dry Hole
75	High Crest #1	21	54	25 W4	3,777	Edmonton	Devonian	High Crest Oils	Dry Hole
76	Redwater Leaseholds-Campbell #1	28	54	25 W4	5,009	Edmonton	Devonian	Redwater Leaseholds	Oil Well
77	Texaco McColl Onoway #1	18	54	27 W4	6,543	Edmonton	Devonian	Texaco Exploration Co.	Dry Hole
78	Amerada Crown #4-11-55-10	11	55	10 W5	2,520	Birch Lake	Devonian	Amerada Petroleums, Ltd.	Dry Hole
79	Imperial Willingdon #1	14	55	15 W4	6,534	Belly River	Pre-Cambrian	Imperial Oil Co., Ltd.	Gas Well
80	Chief Redwater #1	10	55	20 W4	4,182	Bear Paw	Devonian	Chief Redwater Petroleums	Dry Hole
81	Fort Saskatchewan #1	6	55	22 W4	4,748	Edmonton	Devonian	Pacific Petroleums	Dry Hole
82	Imperial Lamoureux #1	8	55	23 W4	5,010	Edmonton	Devonian	Imperial Oil Co., Ltd.	Dry Hole

IMPORTANT WILDCATS DRILLED IN 1949

LINE NUMBER	COUNTY OR LOCALITY	LOCATION SEC. SURVEY	TWP. LAT.	RGE. LONG.	TOTAL DEPTH FT. OR METERS	SURFACE FORMATION	DEEPEST HORIZON TESTED	DRILLED BY	REMARKS * Equals 35 Imperial Gals.
A3	Woodlewood-Devon Carbondale #1	10	55	24 W4	5,000	Edmonton	Devonian	Woodlewood-Devon Oils, Ltd.	Dry Hole
A4	Volmer H. W. #1	16	55	25 W4	3,680	Edmonton	Devonian	H. W. Development Co.	Oil Well-Bailing Rate Fr-2 Bbl./hr
A5	Pacific Calahoo #1	32	55	26 W4	6,000	Edmonton	Devonian	Pacific Petroleums, Ltd.	Gas Well
A6	Alexander Indian Reservation #1	33	55	27 W4	5,542	Edmonton	Devonian	Union Oil Co., Ltd.	Dry Hole
A7	B A Union H. B. St. Paul #5-34	34	56	9 W4	3,439	Milkstone Creek	Devonian	British American Oil Co., Ltd.	Dry Hole
A8	Spike Imbedster Fenwick #1	21	56	19 W4	3,984	Belly River	Devonian	Spike Imbedster Oil Co.	Dry Hole
A9	North Continental Bruderheim #1	4	56	20 W4	4,028	Belly River	Devonian	Taylor Petroleums Co.	Dry Hole
A0	Imperial Simmons #1	25	56	21 W4	3,282	Belly River	Devonian	Imperial Oil Co., Ltd. 1,557 Bbl.*	Oil Well
A1	Imperial Gibbons #1	16	56	22 W4	6,640	Belly River		Imperial Oil Co., Ltd.	Dry Hole
A2	Imperial Bon Accord #1	29	56	23 W4	4,638	Belly River	Devonian	Imperial Oil Co., Ltd. 165 Bbl.*	Oil Well
A3	Imperial Excelsior #1	3	56	24 W4	4,175	Edmonton	Devonian	Imperial Oil Co., Ltd. 178 Bbl.*	Oil Well
A4	Royalite Peavey #1	29	56	25 W4	4,452	Edmonton	Devonian	Royalite Oil Co.	Dry Hole
A5	Imperial Eldorena #1	27	57	20 W4	3,918	Belly River	Devonian	Imperial Oil Co., Ltd.	Dry Hole
A6	Hailey Long Island #1	28	57	25 W4	4,295	Edmonton	Devonian	Northern Development	Gas Well
A7	Anglo Canadian Elk Point # 11	21	57	5 W5	4,449	Lea Park	Cambrian	Anglo-Canadian Oil Co., Ltd. 1,246cf Gas	Gas Well
A8	Stanolind Imperial Barhead #1	10	58	5 W5	6,414	Edmonton	Devonian	Stanolind Oil & Gas Co.	Oil Well
A9	Imperial Lily #1	12	58	23 W4	4,645	Belly River	Devonian	Imperial Oil Co., Ltd.	Gas Well
A0	Pacardville #1	36	58	27 W4	5,005	Edmonton	Devonian	Union Oil Co.	Gas Well
A1	Petromaine Saddle Lake #1	19	59	10 W4	3,385	Belly River	Devonian	Petromaine Exploration Co.	Dry Hole
A2	Wilna Imp #1	12	59	13 W4	3,000	Belly River	Devonian	Barnsdall Oil Co.	Dry Hole
A3	Smoky Lake #1	35	59	18 W4	3,405	Belly River	Devonian	Barnsdall Oil Co.	Dry Hole
A4	Imperial Jeffery #1	4	59	23 W4	4,470	Belly River	Devonian	Imperial Oil Co., Ltd.	Dry Hole
A5	Pacific Sunray Halfway Lake #1	19	59	23 W4	4,435	Belly River	Devonian	Pacific Petroleums, Ltd.	Gas Well
A6	Angelus Ashmont #1	3	60	11 W4	5,714	Belly River		Angelus Petroleums, Ltd.	Gas Well
A7	Imperial Sprucefield #1	31	60	19 W4	3,561	Belly River	Devonian	Imperial Oil Co., Ltd.	Dry Hole
A8	Redwater Consol-British Dm. Yuk #1	31	60	20 W4	3,404	Belly River	Devonian	Redwater Consolidated Oils, Ltd.	Dry Hole
A9	Pacific Nestow #1	13	60	26 W4	3,750	Belly River	Devonian	Pacific Petroleums, Ltd.	Dry Hole
A0	Imperial Pibroch #1	23	60	27 W4	4,279	Belly River	Devonian	Imperial Oil Co., Ltd.	Dry Hole
A1	Canadian Basin John Ouacki #1	31	61	24 W4	3,700	Belly River	Devonian	Canadian Basin Oil Co.	Dry Hole
A2	Imperial Jones #1	11	61	26 W4	5,649	Belly River	Devonian	Imperial Oil Co., Ltd.	Gas Well
A3	Imperial Figure Lake #1	19	62	18 W4	4,452	Belly River	Devonian	Imperial Oil Co., Ltd.	Dry Hole
A4	Imperial Darling #1	19	62	19 W4	6,603	Belly River	Pre Cambrian	Imperial Oil Co., Ltd.	Dry Hole
A5	Stanolind Rochester #1	11	62	23 W4	4,485	Belly River	Devonian	Stanolind Oil & Gas Co.	Dry Hole
A6	Gulf A. Alonso #4	5	62	24 W4	4,834	Belly River	Devonian	Canadian Gulf Oil Co.	Dry Hole
A7	Stanolind Pine Creek #1	11	63	22 W4	3,338	Belly River		Stanolind Oil & Gas Co.	Dry Hole
A8	Stanolind Perryvale #1	11	63	23 W4	4,043	Upper Cretaceous	Devonian	Stanolind Oil & Gas Co.	Dry Hole
A9	Stanolind Meadowbrook #1	24	63	25 W4	4,721	Belly River	Devonian	Stanolind Oil & Gas Co.	Dry Hole
A0	Lime Oils #1	26	64	13 W4	2,551	Upper Cretaceous	Devonian	Barnsdall Oil Co.	Dry Hole
A1	Stanolind Ellscott #1	16	64	20 W4	2,696	Belly River	Devonian	Stanolind Oil & Gas Co.	Dry Hole
A2	Stanolind Plum Lake #1	26	64	21 W4	3,658	Belly River	Devonian	Stanolind Oil & Gas Co.	Dry Hole
A3	Clancy Imperial Sylvan Glen #1	18	64	26 W4	4,225	Belly River	Devonian	Imperial Oil Co., Ltd.	Dry Hole
A4	Bear Mustang #1	9	65	18 W4	3,585	Belly River	Devonian	Bear Oil Co., Ltd.	Gas Well
A5	Continental Ibyle #1	22	65	19 W4	4,750	Upper Cretaceous		Continental Oil Co.	Dry Hole
A6	Barnsdall Flatbush #1	12	66	1 W5	5,000	Belly River	Devonian	Barnsdall Oil Co.	Dry Hole
A7	Bear Parkford #1	3	66	15 W4	5,297	Upper Cretaceous		Bear Oil Co., Ltd.	Dry Hole
A8	Bear Hollywood #1	1	67	21 W4	2,879	Belly River	Devonian	Bear Oil Co., Ltd.	Dry Hole
A9	Fortune Roxana Chrisholm #1	23	68	1 W5	3,653	Belly River	Devonian	Fortune Oil Corp.	Dry Hole
A0	Stanolind Plamondon #1	26	68	16 W4	2,510	Upper Cretaceous	Devonian	Stanolind Oil & Gas Co.	Blew out. Gas fr L. Cret. & Dev.
A1	Stanolind LacLa Biche #1	27	68	14 W4	1,586	Upper Cretaceous		Stanolind Oil & Gas Co.	Well Killed & Plugged
A2	Central Lac La Biche #1	20	69	13 W4	1,545	Upper Cretaceous	Devonian	Central-Ledac Oils, Ltd.	Gas Well
A3	Bear Max George #1	25	69	20 W4	4,382	Upper Cretaceous		Bear Oil Co., Ltd.	Dry Hole
A4	Davies Decalta Hondo #2	23	70	1 W5	3,909	Upper Cretaceous	Devonian	Decalta Oils, Ltd.	Dry Hole
A5	Stanolind Calling Lake #1	21	71	22 W4	2,948	Upper Cretaceous		Stanolind Oil & Gas Co.	Dry Hole
A6	Imperial Clearmont #1	25	72	5 W6	11,710	Edmonton		Imperial Oil Co. Ltd.	Dry Hole
A7	Imperial Wembley #1	9	72	8 W4	11,953	Upper Cretaceous		Imperial Oil Co., Ltd.	Dry Hole
A8	Lyle Lake #1	24	72	17 W4	3,121	Upper Cretaceous		Barnsdall Oil Co.	Dry Hole
A9	Bear Villa #1	8	74	14 W5	6,526	Belly River		Bear Oil Co., Ltd.	Dry Hole
A0	Imperial Spirit River #1	20	78	6 W6	9,847	Upper Cretaceous	Pre-Cambrian	Imperial Oil Co., Ltd.	Dry Hole
A1	Imperial Normandville #1	16	79	22 W5	7,424	Upper Cretaceous		Imperial Oil Co., Ltd. 120 Bbl.*	Oil Well
A2	Bear McMahon #1	15	84	6 W4	1,903	Upper Cretaceous		Bear Oil Co., Ltd.	Dry Hole
A3	Bear Westmount #1	9	86	7 W4	1,703	Upper Cretaceous		Bear Oil Co., Ltd.	Dry Hole
A4	Bear Vanguard #1	28	87	12 W4	2,240	McMurray		Bear Oil Co., Ltd.	Dry Hole
A5	Bear Baltimore #1	11	87	17 W4	2,863	Lower Cretaceous		Bear Oil Co., Ltd.	Dry Hole
A6	Bear Rodeo #2	17	91	9 W4	1,064	McMurray			Dry Hole

	IN PROVEN FIELDS	WILDCATS
Number of wells drilling Dec. 31, 1949	54	23
Number of wells completed during 1949	23	25
Number of gas wells completed during 1949	34	181
Number of dry holes completed during 1949		

Oil And Gas Developments In Iraq During 1949

KIRKUK FIELD

(1) Status of wells

	PRODUCERS	OIL/WATER and OIL/GAS OBSERVATION	DRILLING
Jan. 1, 1949	22	11	2
Dec. 31, 1949	26	16	2

(2) Oil Produced

3.78 million long tons of crude oil were produced in 1949.

The estimated total production to date is 54.25 million long tons.

AIN ZALAH FIELD

The field has a total of six productive wells with a total flowing capacity of 30,000 B/D. There is no pipeline outlet as yet for this production.

Two wells were drilling at the end of the year, one of which is being drilled as a deep test for possible production below the proven Ain Zalah Limestone pay horizon.

South and west of Ain Zalah one gravity and one seismic survey were conducted during the year.

Northwest of Ain Zalah a dry hole was drilled on the Mushoram Dagh structure.

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BASRAH AREA, SOUTHERN IRAQ

Two wells were completed on the Nahr Umr and Zubair seismic structures resulting in two major discoveries. The wells were 8,363 ft and 11,173 ft deep respectively.

Nahr Umr No. 2 and Zubair No. 2 were drilling at the end of the year to prove extensions of the discoveries.

Hatawa No. 1 also located on a seismic high was drilling at the end of the year at a depth of 11,300 ft. The well has had numerous promising shows.

Extensive gravity and seismic surveys continued in the Basrah area throughout the year.

NAFT KHANEH FIELD

(1) Status of wells

	PRODUCERS	OIL/WATER and OIL/GAS OBSERVATION
Jan. 1, 1949	2	2
Dec. 31, 1949	2	2

(2) Oil Produced

The field had an estimated production of 300,000 tons during the year, bringing the total yield to date to approximately 4-million long tons.

PIPELINE

A 16" line was completed from Kirkuk Field to the Mediterranean seaport of Tripoli, Lebanon. This line parallels the previous existing 12" line connecting the same points.

Oil And Gas Developments In Colombia During 1949

By G. F. DEAN * and G. BARROW **

In 1949 production in Colombia reached an all time high with an output of 30,463,743 bbl of crude oil, including 819,768 bbl of condensate. The previous high was attained in 1940 when production reached a total of 25,564,047 bbl. Production in 1949 exceeded that of 1948 by about 25 per cent but in the earlier year the output was adversely affected by labor strikes and civil disturbances. In 1949, the capacity of the Andian National Corporation's pipe line was a limiting factor which made it necessary to restrict production from Shell's Casabe Field to some 60 per cent of its estimated potential. Production by fields is shown in Table 1, that by companies is given below:

COMPANY	CRUDE Bbl	CONDENSATE Bbl	PERCENTAGE OF TOTAL
Tropical Oil	11,856,423	819,768	41.6
Columbian Petroleum	9,460,866		31.0
Shell Oil	7,750,246		25.4
Socony-Vacuum Oil	337,092		1.2
Texas Petroleum	239,348		0.8
Totals	29,643,975	819,768	100

Ninety-one exploitation wells were completed by the industry in Colombia during 1949 as compared to sixty-eight in 1948. Of these 91 completions, only two were abandoned as dry holes. On Shell's Casabe Field in the Middle Magdalena Valley, 45 exploitation wells were completed (1 dry hole); on Colombian Petroleum's Tibu Field, 41 wells were completed, all of them as producers; on Shell's Dificil Field in the Lower Magdalena 3 wells were completed (1 dry hole); while in the Middle Magdalena, the Texas and the Socony-Vacuum Companies each completed a producer at Velasquez and Cantagallo respectively. No new drilling was undertaken during 1949 on Tropical's De Mares concession.

EXPLORATION DRILLING

During 1949, the 10 wildcats drilling at the end of the previous year were completed and abandoned as dry holes; four wildcats were spudded in and abandoned as dry holes; and at one other wildcat location, drilling operations commenced during the year were indefinitely suspended. A summary of the results of these 15 wildcats is shown in Table 2 and their locations are shown on the accompanying map.

As a result of continued lack of success, as well as of continuing unfavorable petroleum legislation, the exploratory drilling effort in Colombia showed a very marked downward trend during the course of the year. Whereas 11 rigs were being used in wildcatting operations in January, this number had been reduced to two by December.

Late in November an encouraging discovery was made by the Texas Company in the Upper Magdalena Valley when, on a three-hour test, their Tetuan No. 1 indicated production of 23° A.P.I. gravity oil at the rate of 744 B/D. Testing operations had not been completed by the end of the year, so that this well is omitted from the list of completions shown on Table 2.

The highlights of exploratory drilling in Colombia during 1949 are summarized below.

Putumayo-Caqueta Basin - Texas Petroleum, the only company to have drilled in this basin, completed their fourth wildcat, Jose Maria No. 1, at a total depth of 5553 ft. Due to mechanical difficulties the hole was abandoned as dry before it had completely penetrated the Eocene section. As in the other three wildcats, all of which were drilled to basement, no important shows were logged. After abandonment of Jose Maria No. 1, the Texas Petroleum Co. drastically reduced their national land holdings in the Putumayo-Caqueta Basin from some 2,200,000 hectares to approximately 930,000 hectares.

Upper Magdalena Basin - In this basin the two Tropical-Richmond joint interest wildcats, Gualanday Nos. 1 and 2 were completed at depths of 6,904 and 2,198 ft respectively. In the No. 1 well, which was abandoned due to mechanical difficulties, several oil and gas shows were recorded but a series of production tests yielded negative results. The nearby Gualanday No. 2 showed some insignificant amounts of gas and oil and was also abandoned.

Texas Petroleum's Cretaceous test Tetuan No. 1, located on a surface structure some 40 kilometers to the south of the Gualanday wells, bottomed in basement at a total depth of 4,579 ft. During testing operations, which had not been completed by the end of the year, the well flowed 23° A.P.I. gravity oil for a three-hour period at the rate of 744 B/D.

Middle Magdalena Basin - On the Cimitarra Concession which lies immediately north of Shell's producing field at Casabe, Shell-Socony completed two more wildcats, Rompida Nos. 3 and 4. Rompida No. 3 bottomed in basement at a total depth of 3,883 ft and yielded 2 to 4 B/D of 15° A.P.I. oil before being abandoned as a non-commercial producer. Rompida No. 4 was abandoned as a dry hole at a total depth of 3,000 ft without having penetrated the Tertiary section.

* CHIEF SCOUT, TROPICAL OIL COMPANY, BOGOTA, COLOMBIA.
** STAFF GEOLOGIST, INTERNATIONAL PETROLEUM CO., LTD., TORONTO, CANADA.

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Paturia No. 1, located on a concession adjacent to Socony's small field at Cantagallo, was drilled by Socony-Shell to a total depth of 9,200 ft before drilling operations were suspended as a result of considerable mechanical trouble. No significant oil or gas shows were logged in either of the Tertiary or Cretaceous sections which the hole penetrated.

Lower Magdalena Basin - Two wildcats were completed during the year in the Lower Magdalena region and a third was drilling at the end of it. Tropical's West Ferdices No. 1, started in 1948, was abandoned as a dry hole at a total depth of 11,695 ft in Cretaceous strata. No oil or gas shows of importance were recorded. Shell's outpost well Dificil No. 19, located six kilometers to the west of their Dificil Field, was drilled to basement and abandoned as a dry hole at 7,018 ft. Shell's Dificil No. 29, a second outpost well five kilometers further west, had been drilled to 9,372 ft by the end of the year and was preparing to test.

Cesar Basin - No additional footage was drilled in Tropical's El Paso No. 2 which at the end of 1948 had reached a depth of 8,783 ft. The well had showed some oil but tests gave negative results and the well was abandoned in the Cretaceous as a dry hole. Shortly afterward the concession on which it was drilled was surrendered.

Ranchería Basin - Cerrejon No. 1, Tropical's second wildcat on their Papayal concession, was drilled and abandoned as a dry hole during the year. It bottomed in basement at a total depth of 7,814 ft. Some small shows of oil were recorded but testing operations yielded negative results. Tropical have now surrendered the Papayal concession.

Guajira Basin - Two wells were completed by the Shell Company in this relatively small basin area but both were unsuccessful. Ranchería No. 1, which had been started in 1948, drilled through a Tertiary section to basement in which it bottomed at 6,243 ft. Though the hole showed some gas, this was of no commercial significance. Ranchería No. 2, located some 700 meters to the southwest of the first well, also penetrated the Tertiary section and was abandoned as a dry hole at a depth of 6,891 ft. Shell have relinquished the concession on which these two wildcats were drilled.

Maracaibo Basin - In that part of the Maracaibo basin which is situated in northeastern Colombia and within which the Barco concession lies, the Colombian Petroleum Co. abandoned as a dry hole their wildcat Tibu No. 87 (Veta No. 1). The well had been drilled during 1948 to a depth of 7,767 ft and no new footage was added in 1949. Drilling started in the Miocene and finished in the Cretaceous with no oil or gas shows of significance reported.

Sinu Basin - Two wildcats, both of them carryovers from 1948, were completed in the Sinu Basin area of northwestern Colombia. Texas-Socony well Sahagun No. 1 was deepened from 5,232 ft to 10,012 ft without completely penetrating the sedimentary section. San Andres No. 2, the second well to be drilled by Sinclair-Cities Service-Richfield interests in Colombia, was deepened from 5,793 ft to 6,586 ft. No shows of any significance were encountered in either of these wells and both were abandoned as dry holes.

EXPLORATION SURVEYS

The industry's exploration effort in Colombia continued to decline as shown in the table below

TYPE OF SURVEY	PARTY MONTHS 1947	1948	1949
Surface Geology	488	299	129
Gravity Meter	72	56	19½
Magnetometer	-	37	14½
Seismograph	133	100	52
Core Drilling	-	-	3
Totals	693	492	218

At the end of 1949 it was estimated that 10 surface geological parties and 3 seismograph parties were available for field exploration work.

CONCESSION ACTIVITIES

The area of national lands which the industry held under concession was reduced during the year from 2,643,126 hectares to 1,601,705 hectares. The reduction in area of national lands for which concession applications have been filed was even more marked, dropping from 17,673,353 hectares to approximately 10,500,000 hectares. Withdrawals from the Llanos basin by Tropical, Shell and Socony and from the Putumayo-Caqueta basin by Texas accounted for nearly half of the application areas dropped.

During the year only 6 applications for national lands concessions, covering an area of some 285,000 hectares, were filed, and no company increased its holdings of national lands. Four companies withdrew entirely from Colombia in 1949.

PIPELINING

Due to increasing production from Shell's Casabe Field in the Middle Magdalena Valley, the existing facilities of the Andian trunk line to the coast were unable to transport the total amount of oil available in 1949 for export from the De Mares, Casabe and smaller fields which tie into the line. Steps were taken to remedy this situation by commencing in mid-year the construction of eight booster pump stations located at strategic intervals along the line. At the end of the year this project was about 85 per cent completed and it was estimated that the additional pumping facilities would be in operation by March, 1950.

LEGISLATION

During 1949 Congress again failed to agree on any of the proposed modifications of existing petroleum legislation, but a decree-law amending oil and tax statutes was issued at the end of the year when Colombia was being governed under martial law. The measure was intended to create incentives for the oil industry by reducing the financial burden on companies engaged in exploratory work and by conditionally increasing depletion allowance. On the other hand, surface rental fees on contracted concessions and royalties on production were augmented by the decree-law.

ACKNOWLEDGMENTS

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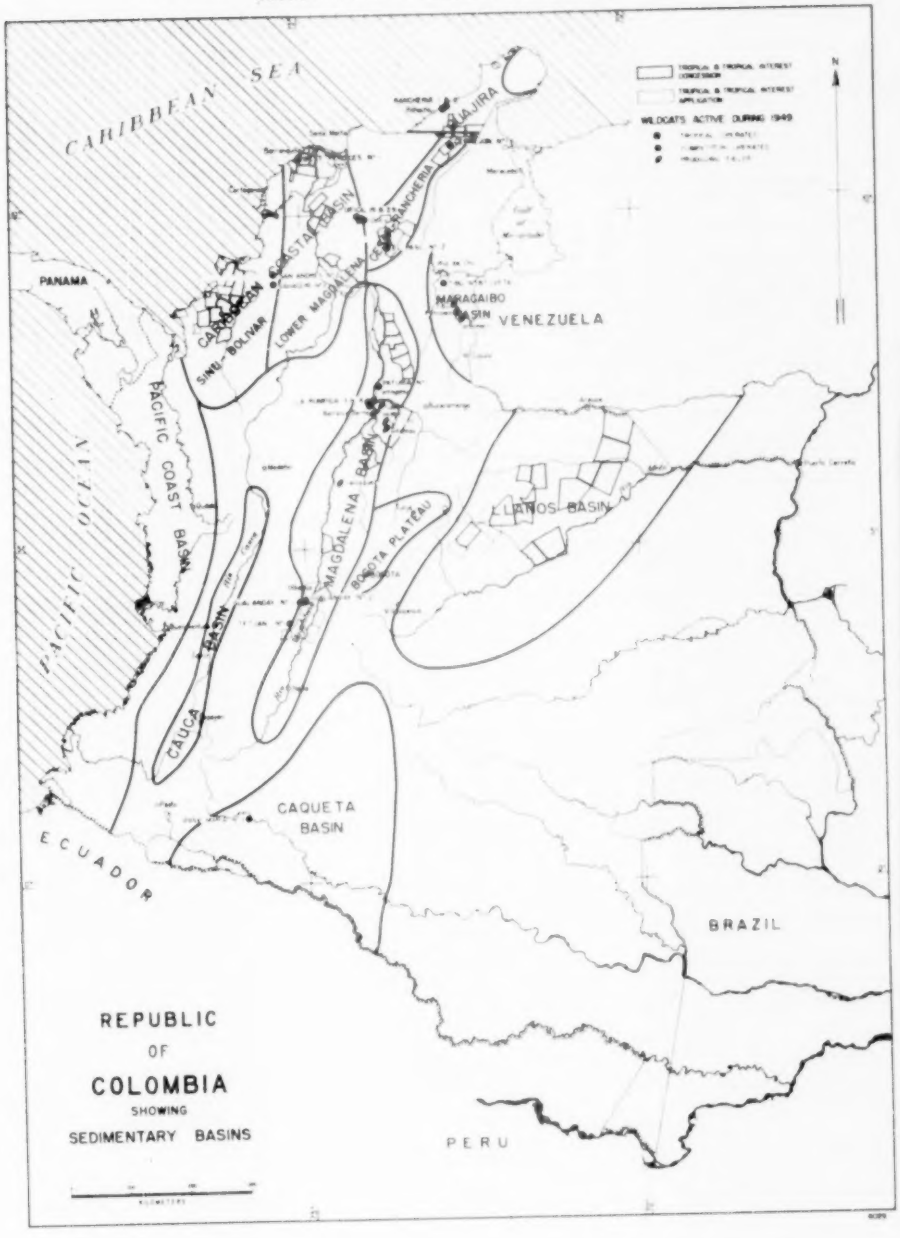
CARIBBEAN SEA
PACIFIC OCEAN
PANAMA
ECUADOR
VENEZUELA
BRAZIL
PERU
GUAJIRA
RANCHERIA
SANTA MARTA
COSTA BASIN
CARTAGENA
SINU - BOLIVAR
LOWER MAGDALENA
MARACAIBO BASIN
PACIFIC COAST BASIN
MAGDALENA BASIN
BOGOTA PLATEAU
LLANOS BASIN
CAUCA BASIN
CAQUETA BASIN
WILDCATS ACTIVE DURING 1949
N
REPUBLIC
OF
COLOMBIA
SHOWING
SEDIMENTARY BASINS

TABLE I - OIL AND GAS PRODUCTION STATISTICS FOR COLOMBIA IN 1949

LINE NUMBER	FIELD (County)[2]	PRODUCING FORMATION NAME AND AGE[3]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO MCF/BBL	CONDENSATE PRODUCTION (Thousands of Bbl)	
				AREA PROVED ACRES	BARRELS TO END OF 1949	BARRELS DURING 1949	AREA PROVED ACRES	MILLION CU FT TO END OF 1949	MILLION CU FT DURING 1949		TO END OF 1949	DURING 1949
1	Cantagallo, *Bolivar*	La Paz, Eoc	1943	500	742	337		555	220	653	0	0
2	Carbonera, *N. Santander*	Barco & Los Cuervos, Eoc	1939	500	152	10					0	0
3	Casabe, *Antioquia*	A, B & C Zones, Olig-Eoc	1941	4,908	21,522	6,227		10,430	3,514	564	0	0
4	Colorado, *Santander*	C Zone, Eoc	1930	270	337	86		794	192	2,236	0	0
5	Difícil, *Magdalena*	Difícil, Olig	1943	2,580	2,307	1,524		3,706	1,644	1,079	0	0
6	Floresanto [1], *Bolivar*	Pajuil, Mio	1945	100	11	0			0		0	0
7	Galan, *Santander*	A Zone, Olig	1945	426	156	33		38	7	213	0	0
8	Infantas, *Santander*	B & C Zones, Olig-Eoc	1915	5,750	152,922	2,914		228,924	4,781	1,640		487
9	La Cira, *Santander*	A, B & C Zones, Olig-Eoc	1926	11,417	236,972	8,823		351,202	12,582	2,426		333
10	Las Monas [2], *Santander*	Olig & Eoc	1926	360	75	0		0			0	0
11	Petrolea (N.Dome)*N. Santander*	La Luna, Capoilo, Uribante, Cre	1933	4,300	30,375	1,733		10,957	1,085	626	0	0
12	Petrolea,(S.Dome)*N. Santander*	Capoilo, Cre	1937	0	42	0		4	0		0	0
13	Rio de Oro, *N. Santander*	Catatumbo, Mato Juan, Cre	1937	420	67	1		61	1		0	0
14	Tetuan, *Tolima* [3]	Villeta, Cre	1949		Not Reported			Not Reported				
15	Tibu, *N. Santander*	Barco, Eoc, Catatumbo, Uribante, Cre	1940	15,360	23,646	7,722		25,822	9,981	1,293	0	0
16	Velasquez, *Boyaca*	Guaduas, Eoc	1946	270	319	237		123	90	380	0	0

1) Abandoned October 6, 1947, as uncommercial.

2) Abandoned March 8, 1948, as uncommercial.

3) First well tested 744 B/D November 24, 1949, but not officially in production at end of year.

LINE NUMBER	NUMBER OF WELLS[a]			WELLS PRODUCING[b] DEC. 1949			RESERVOIR PRESSURE LB PER SQ IN		SECONDARY RECOVERY[c]	CHARACTER OF OIL[d]		PRODUCING FORMATION					DEEPEST ZONE TESTED[e] TO END OF 1949	
	COMPLETED TO END 1949	1949		OIL		GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[f]	POROSITY PER CENT	DEPTH TO TOP OF PRODUCING ZONE FT[g]	PROD. THICKNESS AVG. FT NET	STRUCTURE[h]	NAME	DEPTH OF HOLE, FT
		COMPLETED	ABANDONED	FLOWING	ARTIFICIAL LIFT													
1	12	1	0	3	0	0				20		S	23.5	5,860	160	A F	Basement	7,690
2	3	0	0	0	2	0				21	0.0	S	10.0	800	10	F	Barco, Eoc	3,289
3	144	45	1	12	55	0				30.6	L0	S		2,150	190	A F	Toro, Eoc	8,202
4	15	0	0	2	3	0				36.4		S	4.0	2,200		A	Umir, Cret	6,162
5	29	3	1	10	0	0				42.2	0.0	L S		5,300		A F	Olig.	9,526
6	11	0	0	0	3	0				50.0		S	25.5	644	37	A	Olig	10,876
7	5	0	0	0	3	0	1,338			19.3		S	25.0	4,050	125	A	Mugrosa, Olig	5,003
8	899	0	0	2	280	0			G W	25.4		S	22.0	1,750	300	A F	Cre	4,048
9	844	0	0	3	698	0			G W	22.0		S	24.0	800	302	A F	Basement, pre-Cre	
10	17	0	0	0	0	0												
11	140	0	6	Not Reported			800			45.0	0.0	L S S		950	33	A	Basement	3,007
12	1	0	0	0	0	0	0			37.0		L S		1,000	23	A	Uribante, Cre	2,400
13	13	0	0	0	0	0	800			39.0		S	7.0	1,307	21	A	Uribante, Cre	6,717
																A		4,579
14	0	0	0	0	0	0				23.0								
15	140	44	0	103	31	0	2,100			32.0	0.0	L S S		5000/6000		A	Basement	10,976
16	6	1	0	3	0	0				36.0	0.8	S	30.2	6,800		A F	Basement	8,455

TABLE 2 - SUMMARY OF DRILLING OPERATIONS IN COLOMBIA IN 1949

IMPORTANT WILDCATS DRILLED IN 1949

LINE NUMBER	COUNTY OR LOCALITY	LOCATION SEC.	TWP.	RGE.	TOTAL DEPTH, FT. OR METERS	FORMATION	DEEPEST HORIZON TESTED	DRILLED BY	INITIAL PRODUCTION PER DAY OIL, BBL.	GAS, MILLION CU. FT.	CONDENSATE, BBL.	HOW FLOWING OR AT PUMP	PRESSURE, LB. PER SQ. IN. CASING	TUBING	REMARKS
		SURVEY	LAT.	LONG.											
1	*Antioquia*														15°API-Uncommercl.
2	Barquida No.3				3,683	Quaternary	Basement	Cia. Pet. Ciniturra (Shell-Socony)	2-4						Dry - Abandoned
3	Barquida No.4				3,000	Quaternary	Oligocene								
4	*Atlantico*														Dry - Abandoned
5	W.Perdices No.1				11,695	Mioceno	Cretaceous	Tropical Oil Co							
6	*Bolivar*														Dry - Abandoned
7	Sahagun No.1				10,012	Mioceno	Eocene	La Junta Pet. Co. (Texas-Socony)							
8	San Andres No.2				6,586	Mioceno	U. Cretaceous	Cias. Unidas de Pet. (Sinel.-Gt.S.-Richfd.)							Dry - Abandoned
9	*Cauca*														Dry - Abandoned
10	Rancheria No.1				6,243	Up. Mioceno	Basement	Cia. Pet. Gaviota (Shell)							Dry - Abandoned
11	Rancheria No.2				6,891	Up. Mioceno	Basement								
12	*Magdalena*														Dry - Abandoned
13	Cerrejon No.1				7,814	Eocene	Jurassic	Cia. Pet. Cravo (Tropical)							Dry - Abandoned
14	Official No. 19				7,018	Mioceno	Basement	Cia. Pet. Condor (Shell)							Junked-Abandoned
15	El Paso No.2				8,783	Mioceno	U. Cretaceous	Cia. Pet. Zulia (Tropical)							Dry - Abandoned
16	*N. Santander*														
17	Tibu No. 67 (Veta No.1)				7,767	Mioceno	U. Cretaceous	Colombian Pet. (Texas-Socony)							Junked-Abandoned
18	*Putumayo*														
19	Jose Maria No.1				5,553	Quaternary	Eocene	Cia. Pet. La America (Texas)							Junked-Suspended
20	*Santander*														
21	Paturia No.1				9,300	Quaternary	Cretaceous	New Granada Oil (Socony-Shell)							Junked-Abandoned
22	*Tolima*														Dry - Abandoned
23	Gualanday No.1				6,904	Quaternary	U. Cretaceous	Tropical-Richmond							25°API-Not Officially completed.
24	Gualanday No.2				2,198	Quaternary	U. Cretaceous								
25	Tetuan No.1				4,579	Cretaceous	Basement	Cartagena Pet. (Texas) 744							

	IN PROVEN FIELDS	WILDCATS
Number of wells drilling Dec. 31, 1949	39 (1)	2 (2)
Number of wells completed during 1949	91	15
Number of gas wells completed during 1949	-	-
Number of dry holes completed during 1949	2	15 (3)

1) Includes 22 wells standing incomplete, 14 for lack of pipe-line capacity, 8 awaiting pumping units.
2) Includes Tetuan No. 1, not officially completed
3) Includes Barquida No. 3 (Uncommercial)

Oil And Gas Developments In Egypt During 1949

By E. le M. TRAFFORD *, Member AIME

The main features of petroleum activity in Egypt during 1949 were the continued development of the Asl Field, the discovery of a new productive zone in Ras Matarma, the completion of a successful wildcat at Wadi Feiran and the withdrawal of Standard Oil of Egypt S.A.E. from all active operations.

With Asl Field going on production in January, and an increased offtake from Sudr, crude output in Egypt reached a new high level. Production figures for the year, compared with 1948, were as follows:

FIELD	1948		1949	
	Total	Daily	Total	Daily
Ras Gharib	9,323,314	25,543	8,372,038	22,937
Hurghada	340,902	934	316,845	868
Sudr	3,498,720	9,586	5,447,652	14,925
Asl	-	-	1,670,640	4,577
TOTAL	13,162,936	36,063	15,807,175	43,307

Following the virtual completion of field development in 1948, Sudr output remained steady during the past year. In Asl, however, the productive limits are still not fully delineated, and by October, the average daily production had reached 6,500 B/D, the present limit of pipeline capacity. At the same time, Ras-Gharib and Hurghada fields continued to decline. A new production record for Egypt was achieved in October, when for one week, output averaged 51,000 B/D.

* FIELDS SUPERINTENDENT, ANGLO-EGYPTIAN OILFIELDS LTD. RAS GHARIB, EGYPT.

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The Asl Field had seven producers, all flowing, out of a total of 12 wells drilled by the end of 1949. Structurally, the reservoir consists of an Eocene limestone high, overlain unconformably by Miocene marls and shales, and considerably dissected by block faulting. Porosity in the limestone is the result of weathering, and as in Sudr and Ras Matarma, leads to complete loss of circulation as soon as the productive zone is reached during drilling. The field is still not completely delineated, but its eventual production is not expected to exceed that of Sudr.

The original production at Ras Matarma was obtained from a mid-Miocene sand at a depth of 2,100 ft, in which two producers have now been successfully completed. The last well to be drilled, however, RM-6, located a high block in a residual Eocene boulder bed of the Sudr type at 3,000 ft, and obtained production comparable with the main Sudr and Asl wells. Though no further development of this zone has yet taken place, it is known to be a very narrow fault accumulation and eventual production of the field, which is very limited in extent, will be much smaller than that of Sudr or Asl. The oil has a gravity of 18° and once again, contains no gas. The field is not yet on production.

In January, Standard Oil of Egypt, S.A.E., successfully completed a wildcat at Wadi Feiran, some 150 kilometers down the Sinai coast from Suez. A production of 120 B/D of 24° gravity oil was obtained from a 65 ft Miocene sand, at a depth of 6,505 ft close above igneous basement. This sand is probably equivalent to the mid-Miocene productive zones of Sudr and Ras Matarma. No further development of the area has taken place, but the discovery cannot be considered as one of major significance.

The large number of dry holes in both exploration and development work is due to the complicated geology of the area. The producing beds are those which immediately underlie the Miocene unconformity in a pre-Miocene topographic high. These highs are often complicated by considerable faulting, and often show little reflection in the approximately 3,000-4,000 ft of Miocene sediments

overlying. Seismic work has so far failed to give satisfactory results, and interpretation of gravity is difficult owing to a thick but variable sequence of anhydrite and gypsum (usually the former) near the surface which causes a gravity gradient decreasing downwards within the Miocene. Additional complications are caused by the presence of rock salt. Furthermore, the Sinai Fields are normally very narrow and consequently allow little latitude in the choice of locations, either exploration or production.

Following the passage of the Mines and Quarries Law in 1948, discussions have been taking place between the Government and the oil companies regarding some undesirable features of the Mining Law and the standard license and lease forms. These discussions continued throughout the year and are still taking place. Meanwhile, no new exploration licenses or petroleum mining leases were issued during the year and drilling activities were confined to those already granted. Furthermore, S.O.E., having made their discovery at Wadi Feiran, decided not to develop the area, in view of its apparently limited possibilities and the conditions imposed by the Government for its exploitation. Subsequently they suspended operations altogether and eventually disbanded their organization in Egypt.

During the year the Anglo-Egyptian Oilfields Ltd. increased the throughput of their refinery at Suez from 33,600 B/D to 37,300 B/D, while the Government increased their refinery throughput from 3,650 B/D to 5,700 B/D and have plans for considerably greater expansion. Though crude production is still not sufficient to meet local needs, particularly for kerosine and diesel fuels, it is hoped eventually to refine in Egypt all the crude necessary to supply petroleum products for the home market.

TABLE 2 - SUMMARY OF DRILLING OPERATIONS IN EGYPT DURING 1949

IMPORTANT WILDCATS DRILLED IN 1949

LINE NUMBER	COUNTY OR LOCALITY	LOCATION SEC.	TWP.	RGE.	SURVEY LAT. LONG.	TOTAL DEPTH FT.	FORMATION	DEEPEST HORIZON TESTED	DRILLED BY	INITIAL PRODUCTION PER DAY OIL BBL.	GAS MCF	CONDENSATE BBL.	CHOKE FRACTIONS OF AN INCH	PRESSURE LBS. PER SQ. IN. CASING	TUBING	REMARKS
	A.E.O.-S.V.O.C.															
1	Lagia 3				29°16'14.09" 32°52'20.86"	5,300	Miocene	Nubian	S.V.O.C.							Dry hole
2	Lagia 4				29°14'56.00" 32°54'29.00"	5,524	Eocene	Nubian	S.V.O.C.							Dry hole
3	Nebw 2				29°19'39.23" 32°50'52.27"	5,304	Miocene	Eocene	A.E.O.							Dry hole
4	Nebw 3				29°20'07.43" 32°52'39.32"	5,463	Miocene	Cretaceous	A.E.O.							Dry hole
5	Nebw 4				29°22'45.51" 32°52'24.50"	6,419	Miocene	Cretaceous	A.E.O.							Dry hole
	S.O.E.															
6	Wadi Feiran 1				28°43'25.71" 33°13'25.25"	6,665	Eocene	basal Miocene overlying Granite basement	S.O.E.	120 122			3/4" 1/4"	260 280	100 140	Production from Miocene sand, 6,505-6,570'. Well closed in.

	IN PROVEN FIELDS	WILDCATS
Number of wells drilling Dec. 31, 1949	3	1
Number of wells completed during 1949	0	1
Number of gas wells completed during 1949	-	-
Number of dry holes completed during 1949	12	5

TABLE I - OIL AND GAS PRODUCTION STATISTICS FOR EGYPT IN 1949

LINE NUMBER	FIELD (County)[4]	PRODUCING FORMATION NAME AND AGE[5]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO[7] MCF/BBL	CONDENSATE PRODUCTION (Thousands of Bbl)	
				AREA PROVED ACRES	BARRELS TO END OF 1949	BARRELS DURING 1949	AREA PROVED ACRES	MILLION CU FT TO END OF 1949	MILLION CU FT DURING 1949		TO END OF 1949	DURING 1949
1	Abu Durba	Nubian Sandstone	1921	x	77,880	-	-	-	-	-	-	-
2	Ain	Basal Mio-Eocene Loss of circulation zone	1948	531	1,671,684	1,670,640	-	-	-	-	-	-
3	Gemsa	Miocene Limestone	1908	x	1,420,803	-	x	x	-	-	-	-
4	Hurghada			649	37,101,068	316,845		x	x	x	-	-
	Eastern Anticline	Mio and (C & D) Carboniferous	1914		x	x	-					
	Main Field	Series	1914		x	x	-					
	North Field	Basal Mio & (C & D) Carboniferous Series	1924		x	x	-					
5	Ras Gharib				86,804,385	8,372,098	-	13,998.3	1,558.3	186	414,470	65,917
		Miocene Limestone	1943	887	10,259,645	2,267,775	-					
		Cretaceous Sand	1943	580	2,865,652	793,823	-					
		'A' Series Sand (Jur[1]/ Cre ?)	1939	448	27,709,676	2,129,438	-					
		'C' Series	1940									
		'C&D' Series (Carboniferous Sand)	1938	776	45,971,412	3,181,022	-					
		'D' Series										
6	Ras Matarma			192								
		Mio L	1948	117	-	-	-	-	-	-	-	-
		Eoc Loss of circulation zone	1949	75	-	-	-	-	-	-	-	-
7	Sudr	Basal Mio-Eocene Loss of circulation zone	1946	1,504	9,065,115	5,447,652	-	-	-	-	-	-

1/ One completed as a water well.

e Those wells are not on actual production.

x Represents an average figure or an unavailable record.

LINE NUMBER	NUMBER OF WELLS[4]			WELLS PRODUCING[4] DEC. 1949			RESERVOIR PRESSURE LB. PER SQ. INCH		SECONDARY RECOVERY[5]	CHARACTER OF OIL[6]		PRODUCING FORMATION					DEEPEST ZONE TESTED[7] TO END OF 1949	
	COMPLETED TO END 1949	1949		OIL		GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[1]	POROSITY PER CENT	DEPTH TO TOP OF PRODUCING ZONE FT.	PROD. THICKNESS AVG. FT. / RT	STRUCTURE[8]	NAME	DEPTH IN HOLE, FT.
		COMPLETED	ABANDONED	FLOWING	ARTIFICIAL LIFT													
1	11	-	9	-	-	-	x	x	-	15.0	1.4	S		170-1,108	50-90	S.F.	Igneous basement	365
2	12	6	2	7	-	-	1,024	x	-	22.2	2.18	L		3300	385	A.F.	Eocene	4,328
3	32	-	x	-	-	-	x	-	-	40.0	x	L		750-1500	x	M.F.		
4	143	1	10	-	19	-		-									Igneous basement	3,600
							x	x		38.5	2.5	L/M.d.		1450-1900	0-120	M.F.		
							x	x		22.5	2.5	S		1530-3000		A.F.		
							585	585		31.5	1.5	L/M.d.		2000-2500	0-140	A.F.		
																	Igneous basement	3,614
5	123	1	-	21	98	-				25.6	2.7							
	10	1	-	6	2	-	852	672		x	x	Lr		1497	204ft	M.C.		
	18	-	-	2	9	-	794	500	-	x	x	S		1714	63ft	M.F.		
	40	0	-	-	25	-	832	x	-	-	x	S		1747	396ft	M.F.		
	17	-	-	2	10	-	803	x	-	x	x	S		1833	121ft	M.F.		
	11	-	-	3	3	-	--	-	-	-	-							
	27	-	-	8	9	-	780	740	-	x	x	S		1954	448ft	M.F.		
																	Cret.	4,324
6	3	1	2	3	-	-	962	x										
	2	1	2	2	-	-			-	31.0	2.2	Cd.		1600-1800	80-390	M.F.		
	1	-	-	1	-	-			-	22.5	1.86	L		2800	300ft	M.F.		
7	18	2	2	6	1		985	x	-	22.5	1.86	L		2580-2860	15-295	A.F.	Nubian	6,334

FIG. 1 — ACTIVE AREAS IN OCEANIA, CHINA AND JAPAN

Oil And Gas Developments In The Far East During 1949

Including OCEANIA, CHINA, JAPAN, INDONESIA, NORTH SUMATRA, MID-SUMATRA, SOUTH SUMATRA, BRITISH BORNEO, NORTHEAST BORNEO (Tarakan), SOUTHEAST BORNEO, NETHERLANDS NEW GUINEA, CHINA, PHILIPPINES, PAPUA and MANDATED TERRITORY (Eastern New Guinea), AUSTRALIA, FORMOSA, JAPAN and ASSAM.

OCEANIA, CHINA and JAPAN

The year 1949 was a period of political readjustment in the Far East not particularly conducive to creating a healthy atmosphere in which industry and commerce could expect normal growth. Nevertheless, substantial gains in petroleum development were made.

The contribution which is being made by the countries of the Far East to the world's crude oil output is relatively small when compared with that of North America, South America and the Middle East. This output, amounting to 202,000 B/D in 1949, is nevertheless a substantial one and plays an unusually conspicuous role in the world's supply picture because of its geographic and strategic location with reference to one-third of the world's population.

INDONESIA - GENERAL

Indonesia became a new political unit among the world's family of nations late in the year. Growing pains of this new island nation were intense and at times violent. However, law and order were established to a marked degree and new areas were opened for commerce and exploration. The new Indonesian government recognized the binding contracts and agreements of the former government. However, there was considerable agitation for nationalization of industries.

The progress made by the petroleum industry is indicated by the following table showing production of crude oil in Indonesia.

CRUDE OIL PRODUCTION (in U.S. Barrels)

	Yearly Total	Daily Average	Production to Date
1948	31,686,209	86,574	1,141,073,209
1949	42,221,285	115,675	1,183,294,494

Figure 1 indicates the location of areas reported on, numbered for ready reference corresponding to the paragraphs which follow.

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1. NORTH SUMATRA

The improvement in security late in 1949 in this area permitted the former owners of petroleum installations to survey and plan rehabilitation. The prewar refinery of the Shell interests at Pangkalan Brandan, destroyed during the war years, was surveyed as were also the prewar producing areas of that company.

It is estimated that approximately 500 B/D of crude oil were produced for local use during early 1949 before the prewar owners were able to re-enter the area.

Exploration activities were increased over 1948 in this area. Party months of seismic exploration were increased from seven in 1948 to 12 in 1949 and four geological party months and 18 gravity meter party months were added. No exploration or development drilling was done during the year.

2. MID-SUMATRA

Exploration activity in this area consisted of seven party months of geological work and 11 party months of gravity meter exploration. Five producers were completed in the prewar Lirik Field by SVPM (Standard-Vacuum) and one in the Minas (Caltex) Field. Surface field facilities were constructed by both SVPM and NPPM (Caltex). Approximately 5,000 bbl of crude were produced during the year for use locally. No outlet for crude oil has yet been developed although six producing structures have been partially outlined. The operators feel that Mid-Sumatra will become an important producing center.

3. SOUTH SUMATRA

Exploration activities were carried on at a rather high level during the year, consisting of 14 party months of geological work, 36 party months of seismic work and 28 party months of gravity meter work. In addition, 12 wildcat tests were drilled resulting in an extension to the prewar SVPM Radja Field and the discovery of two gas reservoirs by BPM (Shell) at Lebong and SVPM at Ruang.

A total of 103 development tests were drilled, resulting in 94 producers.

The fields in South Sumatra produced at the rate of 97,600 B/D during 1949, compared to 69,500 B/D in 1948.

Both the BPM (Shell) refinery and SVPM (Standard-Vacuum) refinery were back on prewar levels of operation.

4. BRITISH BORNEO

Exploration in British Borneo included 43 party months of geological work and 24 party months of seismic work during the year 1949.

One exploration well near the old Miri Field was completed with negative results. Fourteen development wells were drilled in the Seria Field in 1949 compared to 22 drilled in 1948. The Seria Field is producing at a rate of 67,700 B/D whereas the almost depleted Miri Field has dropped to approximately 1,100 B/D.

CRUDE OIL PRODUCTION (IN U.S. BARRELS)

	YEARLY TOTAL	DAILY AVERAGE	PRODUCTION TO DATE
1948	20,125,295	55,000	152,412,629
1949	25,112,322	68,800	177,524,951

5. NORTHEAST BORNEO (Tarakan)

Exploration activity in this area consisted of 12 party months of geological work and three gravity meter party months.

An important discovery was the wildcat test at Poeloe Boemjoe which came in as a substantial producer. One additional exploration deep test was a failure at Sesanip.

The Tarakan Field was produced during the year at a daily average rate of 7,877 B/D compared to a rate of 7,315 B/D in 1948.

6-7. SOUTHEAST BORNEO

Exploration in this area consisted of 28 party months of geological work, one seismic party month and 11 party months of gravity meter work. No exploration drilling was carried out.

Five development wells were completed.

CRUDE OIL PRODUCTION (IN U.S. BARRELS)

	TOTAL 1948	DAILY AVERAGE	TOTAL 1949	DAILY AVERAGE
Louise	2,778,664	7,613	2,732,875	7,487
Sambodja	329,140	902	435,876	1,194
TOTALS	3,107,804	8,515	3,168,751	8,681

8. JAVA

Exploration effort in Java consisted of 22 party months of geological work and the drilling of one wildcat test at Poeloengan, a dry hole.

Kawengan, the most important producing center in Java, was repossessed by its owners and rehabilitation started.

The Java production was taken from the Kroeka Field near Soerabaja which was produced at the rate of 1,442 B/D during the year compared to 1,302 B/D for the year 1948.

9. NETHERLANDS NEW GUINEA

Six exploration tests have been drilled in the Vogelkop area of Wester New Guinea throughout most of 1949, but only one, at North Klamono, has been completed and abandoned as a dry hole.

Both drilling and exploration are necessarily slow in this difficult and almost inaccessible region. An exploration program is currently being carried on with two geological parties, one seismic and one gravity meter party.

SUMMARY OF EXPLORATION ACTIVITIES

	Geological Party Months	Seismic Party Months	Gravity Party Months
New Guinea	25	12	9

The Klamono Field in the Vogelkop area of Northwestern New Guinea has accounted for the increase in production from 136,493 bbl in 1948 to 1,743,588 bbl in 1949. An eight-inch pipeline was completed over the 30 miles between Klamono and the sea coast at Sorong in December 1948 and has been in service throughout 1949.

Ten exploitation wells were completed in the shallow Klamono Field during 1949. The reservoir of this field is a reef limestone and production from wells within the field varies considerably from well to well.

CRUDE OIL PRODUCTION (IN U. S. BARRELS)

	YEARLY TOTAL	DAILY AVERAGE	PRODUCTION TO DATE
1948	136,493	373	136,493
1949	1,743,588	4,777	1,880,081

10. CHINA

It has been reported that at the time the Communist regime took over the northwest provinces of China, the Laochunmiao (Yumen) oil field in Kansu was producing at the rate of 2,000 B/D. The discovery well in this field was completed in 1939. Nine wells were drilled during 1948 and all but one have been indicated as producers. The latest information at hand indicates seven locations were to be drilled in 1949, and it is assumed that these were completed. It is known that one well blew out and caught fire but was brought under control late in 1949. Pressure declines in the crestal part of the field necessitated curtailment of production in this area.

It has been reported also that most of the personnel of the Chinese National Resources Commission, who were responsible for development of petroleum resources in China, have been taken over by the Ministry of Fuel Industry of the Central Government of China, and since the Laochunmiao Field is the only major source of crude production in China, it is assumed that operations in this field have continued throughout 1949.

A small refinery at Laochunmiao processes the entire production of the field for consumption in Northwest China. The crude oil yields the following products:

Straight run gasoline	20%
Cracked gasoline	16%
Kerosene	10%
Gas Oil	5%
Fuel Oil and Residue	49%

11. PHILIPPINES

The Philippine Oil Development Company was the only company engaged in drilling operations in the Philippines in 1949. While a new petroleum law (Republic Act No. 387) was enacted by the Philippine Congress in the middle of 1949, no concession was granted under its provisions and the seven applications for exploration concessions covering a total area of 211,844 hectares (523,466.5 acres), filed after the taking effect of the new law were still pending in the Philippine Bureau of Mines at the close of the year. The petroleum claims and leases held under old oil laws are in the province of Quezon (formerly Tayabas) on Bondoc Peninsula and in Cebu province totaling 19,219 hectares.

After drilling two holes in previous years on its lease on Bondoc Peninsula acquired under the old petroleum law, a third hole was drilled in 1949 by the Philippine Oil Development Company on the same area. As in the two wells drilled in previous years, considerable trouble was encountered in this well due to frequent cavings caused by the highly fractured character of the bentonitic shale. However, in the course of drilling, there were reported intermittent flows of oil which were encouraging.

The seismographic survey of the area at Dam Bantayan in Cebu province leased to the same company was completed on December 7, 1948. Based on the result of the geophysical survey a new well, Well No. 3, was drilled in the same area. Drilling operations commenced on September 18, 1949 and a depth of 7,643 ft was reached on the 15th of December of the same year. It was reported that drilling was discontinued at this depth. In the meanwhile, the casing was perforated at 2,260 ft to 2,074 ft zone, where, in the course of drilling, a strong salt water and gas flow was encountered. Another gas and salt water flow was encountered at 3,830 ft. Gas and oil colors were noted in the hole. From December 19 to the end of the year, the gas flow averaged 82,000 cu. ft. per 24 hours, with indications of increasing rate. At the close of the year samples of the gas collected in the first zone were sent to the United States for analysis. The company reported on January 21, 1950 that the result of this analysis is as follows:

"Following Podbielniak analysis performed by Charles Martin Company, Houston, Texas, on samples recently received:

1. Classified as natural petroleum gas

2. Mol percentage:

Methane	98.86
Ethane	.62
Propane	.30
Isobutane	.08
Normal Butane	.14

3. Liquid volume percentage:

Methane	98.18
Ethane	.93
Propane	.48
Isobutane	.15
Normal Butane	.26

4. Specific gravity calculated .5645

5. BTU per cubic foot 1025[1]

The above analysis compares satisfactorily with some representative analyses of petroleum gases from various United States fields as published in the United States Bureau of Mines Bulletin No. 88."[2]

The limited drilling activities of the Philippines may be attributed to the suspension of the granting of geological and petroleum drilling leases under the old oil law since 1939 which suspension continued until June 18, 1949, when the Petroleum Act took effect. The new law was enacted after an oil mission, which was sent abroad, made a study of the petroleum legislations of different foreign countries and conducted therein investigations of petroleum operations. The main object of the new law is to promote and encourage the exploration, development, and utilization of the prospective petroleum lands of the Philippines as much as possible by private enterprise, looking toward the establishment of a wholly integrated domestic industry with an equitable distribution of benefits between such private enterprise and the Government.

The total land area of the Philippines, not including the Philippine shelf to which the Government has asserted jurisdiction under the new oil law, is approximately 29 million hectares, about half of which is covered by sedimentary formations. These areas, whether public or private lands, are open to application for petroleum concessions by citizens of the Philippines and, during the effectivity of an executive agreement between the Philippines and the United States, by citizens of the latter and all forms of enterprise owned or controlled by such citizens.

Exploration concessions should be in blocks of not more than 100,000 nor less than 20,000 hectares. No applicant can acquire more than 500,000 hectares of exploration areas within one petroleum region nor more than 1,000,000 hectares in the whole Philippines.

The term of an exploration concession is four years twice extendible for a period of three years each. During the exploration period the concessionaire is obliged to pay the Government an annual exploration tax of from P0.05 per hectare for the first year increasing gradually to P0.125 per hectare for the 10th year.

The exploration concessionaire may apply for exploitation concession not exceeding one-half of the area covered by his exploration concession. The other half reverts to the State and becomes a part of the national reserve. The Government is obligated to grant exploitation concession to a holder of exploration concession within the area covered by his exclusive exploration concession. The exploitation concessionaire pays the Government an annual exploitation tax as follows:

P0.50 per hectare for the 1st five year period
P1.00 per hectare for the 2nd five year period
P1.50 per hectare for the 3rd five year period
P3.00 per hectare for the 4th five year period
P5.00 per hectare for the 5th five year period and thereafter if there is any renewal.

A royalty of 12-1/2 per cent of the petroleum produced is paid to the Government. The exploitation tax in excess of P0.50 per hectare to which a concessionaire may be liable in any petroleum region is offset by the royalties for his production in the same region. The work obligations, taxes, and royalties provided in the new law shall not be changed during the life of the concession to which they apply.

The Government may undertake the exploration, development, and exploitation of the Philippine petroleum resources either by itself or through its instrumentalities or through competent persons under a contract of service to be executed for the Republic of the Philippines by the President and approved by the Congress of the Philippines in accordance with the provisions of Articles 5 and 13 of the new oil law. In this way responsible foreign oil operators having the necessary capital, organization, and technical competence may enter into the search for oil in the Philippines and be assured of their status even beyond 1974, the time limit set in the executive agreement between the United States and the Philippines, under such terms and conditions as are considered fair and reasonable to both parties.

With this new law containing provisions believed to be liberal enough for companies desiring to search for oil in this country, it is hoped that there will be more petroleum activities in the Philippines in the years to come.

12. PAPUA AND MANDATED TERRITORY (Eastern New Guinea)

Exploration drilling and geological and geophysical field work continued in Papua and the Mandated Territory throughout 1949. The drilling program of the Australasian Petroleum Company, Ltd., has been accelerated by the use of three drilling units. Three wells were drilling throughout most of the year at Oroi, Upoia and Hohoro. Oroi was abandoned in November as a dry hole at 5,500 ft, Upoia No. 1 and Hohoro No. 1 continued drilling. Heaving and highly fractured shales made drilling conditions very difficult at Upoia and Hohoro. Shows of gas were reported at shallow depths in both wells.

Four additional well sites are being prepared for drilling in the Delta area of Southwestern Papua. Two of these wells are expected to be spudded during 1950. Because of the almost inaccessible nature of all but coastal areas of Papua, many months of preparation for exploration and drilling projects are usually required before operations can be started. The shortage of skilled and unskilled labor presents another problem which limits the size and speed of exploration and drilling projects.

No commercial production has been developed to date in Papua or the Mandated Territory, but large basins of thick sediments are sufficiently promising to stimulate additional exploration and test drilling in this vast region. The growing Australian demand for petroleum products is an additional incentive.

SUMMARY OF EXPLORATION ACTIVITIES

	GEOLOGICAL PARTY MONTHS	SEISMIC PARTY MONTHS	GRAVITY PARTY MONTHS
Papua and Mandated Territory	24	12	12

13. AUSTRALIA

Exploration of areas where sections of sedimentary formations offer any hope for recovery of petroleum products has continued in four principal areas of Australia during 1949.

The greatest amount of activity took place in the eastern part of the Great Artesian Basin of Central and Eastern Australia. Near Roma, where encouraging shows of gas and oil have been found in wells drilled before the war, the Commonwealth Bureau of Mineral Resources and technicians of the Queensland state government have combined exploration forces with the geologists of four companies holding prospecting permits and petroleum leases in this area to thoroughly examine 1,000 sq mi of the eastern section of the Cretaceous Basin. One geological party, one gravity meter party and one magnetometer party have been active in this area throughout 1949. It is reported that a seismograph party will be used in the Roma area during 1950.

In the Rolleston District, 150 miles north of Roma, the Shell Development Company, Ltd. announced that a five-year exploration program has led to a suitable location for a deep test in the Paleozoic Basin of East Central Australia. A well to be drilled to 10,000 or 12,000 ft is expected to be started near Rolleston early in 1950. A geological party has carried out structural drilling in this area during 1949.

In the southwest portion of the Great Artesian Basin, the Australian Zinc Corporation has continued to explore for gas production in the Lake Frome Area. One geological party was active in this area during 1949. The Koppermanna test which was started in 1948 was abandoned as a dry hole at 3,250 ft early this year. This well was drilling in Jurassic formations when abandoned. A second well (Lake Cootabarlow), 100 mi southeast of Koppermanna, was drilled to 1,600 ft where basement was encountered. A heavy flow of artesian water was encountered in this well.

In the Northwest Basin of Western Australia, Ampol, Ltd., (Australian Motorists Petroleum Company) continued to stimulate public interest with reports from a reconnaissance geological survey carried out during 1949. It was reported that one Commonwealth geological party worked with geologists of Ampol in this area and in the Desert Basin to the northeast.

The large paleozoic Desert Basin area of Western Australia has been under exploration for a number of years and several wells have been drilled in it. The Freney Kimberley Oil Company has been drilling on their Nerrima test in the lower Fitzroy River region since before the war. Operations were shut down early in the war when the well had reached 4,271 ft and it was reported that work was resumed early in 1949 but was suspended in September at the approach of the rainy season. At that time a fishing job was in progress.

At Lake Entrance (Gippsland), Victoria, in Southeastern Australia, Lake Oil Ltd. continued to produce a small amount of oil by drilling horizontally into an oil sand from the bottom of a 1,200 ft shaft. The recovery has been reported at three B/D, the only oil production in Australia. This production is from a Tertiary overlap onto Paleozoic formations.

A few areas of sedimentary formations were covered by airborne magnetometer surveys.

SUMMARY OF EXPLORATION ACTIVITIES

	GEOLOGICAL PARTY MONTHS	AIRBORNE MAGNETOMETER PARTY MONTHS	GRAVITY-MAGNETIC PARTY MONTHS
Australia	48	1	12

14. FORMOSA - JAPAN

FORMOSA:

No report on petroleum operations in Formosa during 1949 is presently available, but it is known that the Kaohsiung refinery was rehabilitated during 1948 and is capable of a throughput of 15,000 B/D. At least one gravity party of the Chinese Petroleum Corporation has been active in the flat coastal regions of Western Formosa and some drilling may have been carried out. Production, including casinghead gasoline, is thought not to exceed 20,000 bbl for the entire year, or about 50 B/D.

JAPAN:

With the continued aid and advice of the Petroleum Resources Development Promotion Council, which was formed during the last half of 1949 to replace the Petroleum Exploration Advisory Group of the National Resources Section of the Occupation Forces, the oil production of Japan has shown a small but steady increase throughout 1949. The total production of Japan reached 4,500 B/D during October 1949 and will average 3,750 B/D for the year, as compared to a daily average of about 3,060 bbl during 1948.

The oil fields are located in a narrow belt along the northwest coastal zone of the main Japanese island of Honshu and near the western coast of the northernmost island of Hokkaido. All production to date is derived from beds in Pliocene and Upper Miocene formations.

In Honshu there are three principal producing areas within three rather shallow sedimentary troughs; from south to north these are Niigata, Yamagata and Akita. During 1949 most of the drilling activities were confined to the development of one small field in the Niigata area, one in the Yamagata district and to the development of deeper sands in the Yabase Field of the Akita district.

The Yabase Field produces 35 per cent of the total crude oil of Japan, or about 1,500 B/D. During 1949 a new producing horizon was discovered at about 3,800 ft, some 400 ft below Zone VII which had hitherto produced most of the oil. This new deeper horizon has been proved to underlie most of the previous outline of the Yabase Field and has added at least 6,000,000 bbl to the previous total of 15,000,000 bbl of proved reserves for all of Japan.

A deep test in the northern part of the Yabase Field, which was drilling at the end of 1949, has indicated two additional productive horizons below the new Zone VIII, one at 4,200 ft, the other at 5,100 ft.

During the year, 12 new producers were drilled in Japan. In addition to the deep test in the Yabase Field, a deep well is being drilled on the Kawaguchi structure in northwest Hokkaido, where it is hoped to test the Cretaceous formations of that area. The objective depth for this well is 7,000 ft, but at the end of 1949 it was shut down at approximately 3,000 ft because of a large show of gas at that depth. Total footage drilled during 1949 was 167,831 ft as compared to 89,314 ft in 1948.

Petroleum exploration has been continued during the active field season of 1949, from April until November. A number of geological field parties examined the outcrops of the foothills to the east of the three producing sedimentary basins to obtain better stratigraphic information and to assist in locating possible shoreline and other stratigraphic trap fields. One field party continued the survey of the outcropping formations on Noto Peninsula in order to evaluate the productive possibilities of Toyama Basin. Exploration of the Bozo Peninsula southwest of Tokyo continued, as did also work in the Cretaceous basin of Western Hokkaido.

SUMMARY OF EXPLORATION ACTIVITIES

	GEOLOGICAL PARTY MONTHS (APPROXIMATELY)	SEISMIC PARTY MONTHS	GRAVITY PARTY MONTHS
Japan	36	24	18

There follows a table comparing the monthly production of crude oil in Japan during 1948 and 1949.

CRUDE OIL PRODUCTION (in U.S. Barrels)

	1948	1949	REMARKS
January	94,891	81,356	Seasonal Low
February	90,935	89,387	Seasonal Low
March	100,866	105,213	
April	98,784	108,219	
May	97,080	116,931	
June	105,697	113,906	
July	101,911	118,824	
August	38,061 (strike)	120,277	
September	105,641	121,340	
October	107,238	134,681	
November	96,728	126,718	Seasonal Low
December	84,317	131,555	Seasonal Low
TOTALS:	1,122,149	1,368,406	
DAILY AVERAGE:	3,066	3,749	

Cumulative crude oil production in Japan since 1874 is slightly over 94,000,000 bbl.

15. BURMA

See page 404 for report on Burma.

16. ASSAM

The Assam Oil Company continued its exploration program at about the same level of activity at which it operated in 1948.

New extensions in the Digboi Field were responsible for the increase in producing capacity from 5,300 B/D in 1948 to 5,500 B/D in 1949.

Three wildcat tests were completed as dry holes.

PRODUCTION BY FIELDS (in U.S. Barrels)

	TOTAL		DAILY AVERAGE	
	1948	1949	1948	1949
North Sumatra	-	-	-	-
Atjeh-Sumatra	-	5,000	-	14
South Sumatra				
Talang Djimar	8,984,522	6,469,768	24,615	17,723
Tandjong Tiga	58,180	1,232,907	159	3,378
Limau	372,413	529,593	1,020	1,451
Soeban Djerigi	291,905	276,747	800	758
Lemboh	-	629	-	2
Mangoendjaja	-	229,008	-	627
Babat	-	2,201	-	6
Goemoeng Kemala	-	30,191	-	83
Radjoebasa	-	656,645	-	1,799
Tempino	-	2,229,699	-	6,109
Kenali Asam	-	2,363,669	-	6,476
Talang Akar	11,637,104	15,856,860	31,795	43,443
Djirak	1,294,859	1,759,833	3,538	4,821
Benakat	2,577,650	3,038,552	7,043	8,325
Kruh	51,705	231,553	141	634
Radja	164,331	741,342	449	2,031
Sub-Total	25,432,669	35,648,197	69,560	97,667
Java				
Kroeka	475,124	528,335	1,302	1,447
Southeast Borneo				
Louise	2,778,664	2,732,875	7,613	7,487
Sambodja	329,140	435,876	902	1,194
Northeast Borneo				
Tarakan	2,669,852	2,875,022	7,315	7,877
New Guinea				
Klamono	136,493	1,743,588	373	4,777
British Borneo				
Seria	19,762,866	24,693,362	54,145	67,653
Miri	361,469	417,762	990	1,145
China (Estimate)	365,000	401,500	1,000	1,100
Formosa (Estimate)	23,000	20,000	63	50
Japan	1,122,149	1,368,406	3,066	3,749
India				
Attock	558,400	565,750	1,530	1,550
Assam	1,926,500	2,007,500	5,300	5,500
Grand Total	55,941,326	73,443,173	153,159	201,210

Oil And Gas Developments In Germany During 1949

By PROF. DR. A. BENTZ

ABSTRACT

German crude oil production reached a postwar record of 841,511 tons in 1949, and was at the rate of about 80,000 tons/month in December. This was sufficient crude oil to cover roughly one-third of the requirements of the western zones of Germany, and represents about 32.4 per cent increase over 1948 production.

The increase in German production was due above all to the continuing development of the Georgsdorf, Emlichheim and Lingen fields in the Emsland district adjacent to the Dutch border in western Germany. Two important new fields, at Ruhlertwist-Ruhlermoor and Scheerhorn, were also discovered in this area during 1949.

The decline of the salt-dome fields in the old Hanover district was slowed somewhat by unexpected extensions to the producing areas in several fields, and there were two important new pool discoveries in this area, at Suderbruch and Eldingen, which may suffice to reverse the production trend of the Hanover district during 1950. Two new fields of apparent importance were also found in Schleswig-Holstein, in the extreme northwest of Germany, at Elpersbuttel and Hohenhorn.

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GENERAL

In the "Emsland" was found the great field Ruhlertwist-Ruhlermoor, an anticline of 10 km length and 3-4 km broad. The reserves are estimated to be 6,000,000 tons proven and 6,500,000 tons probably. In the same area between the anticlines of Georgsdorf and Adorf the greatest surprise was to find here the first stratigraphical trap of Germany. In the well Scheerhorn No. 1, the productive horizon of the Emsland, the Bentheim-sandstone of the Valendis (Lower Cretaceous) is sealed by the transgression of the marls of Middle Albian. The location was based on a very thorough reflection-seismic work carried out by our new American instruments.

The two new fields of the old Hanover district are not of less interest. In this area were hitherto only salt-dome oilfields of different kinds, most of it on the flank of the domes, some over the top of the salt and some below a great overhang of salt. It is of greatest importance that with the Suderbruch field, it was discovered for the first time an oilfield between the salt domes on a deep seated anticlinal structure buried under the transgression of the Cretaceous. The light oil comes from the Cornbrash, a sandstone of Upper Dogger age, at a depth of 2,040 m. A similar anticline between the salt structures was tested near Eldingen and proved a production from sandstone of the Lower Liassic. There are opened quite new possibilities for future exploration.

TABLE I - OIL AND GAS PRODUCTION STATISTICS FOR GERMANY DURING 1949

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl	
				AREA PROVED ACRES	BARRELS TO END OF 1949	BARRELS DURING 1949	AREA PROVED ACRES	MILLION CU FT[c] TO END OF 1949	MILLION CU FT[c] DURING 1949		TO END OF 1949	DURING 1949
1	Adolfglück	Ibhetic, Tri	1936		305	25						
2	Brunstedt	Valendis-Wealden, Cre L	1937	9	32,148	5,201						
3	Calberlah	Lower Lagger, Jur	1945	1	3,121	1,570						
4	Edesse-Ohm	Saddle ibhetic, Tri	1939	10	235,197	2,209	10	0.4	0.1			
5	Ehra	Lower Lagger, Jur	1939	9	9,775	603						
6	Fackingen	Valendis-Weald., Cre L	1937	20	252,946	10,777						
7	Falte	Wealden, Cre L	1942		784	454						
8	Eichingen	Lias, Jur L	1949	Exploration Wells only	38	38						
9	Etzel	Lower Lagger, Jur	1942	6	23,852	2,769						
10	Fahrberg	Cornbrash., Jur	1939	150	402,105	42,827						
11	Gifhorn	Wealden, Cre L	1935	17	41,339	1,706						
12	Hademstorf	Wealden, Cre L	1941	47	56,619	14,102						
13	Hankelohen	Cornbrash, Jur	1941	10	28,005	7,814						
14	Hangeen	Wealden, Cre L	1940	48	361,133	37,235						
		Valendis, Cre L	1941									
15	Hohenassel	Corallian, Jur	1943	23	153,657	18,714						
16	Heckel feld	Upper Cretac., Cre U	1939	40	47,954	2,892		3	0.3	14		
17	Nalne	Ibhetic, Tri	1935									
		Wealden, Cre L	1937	40	135,835	5,251						
		Corallian, Jur	1941									
18	Nienhagen	Ibhetic, Tri	1900									
		Valendis, Cre L	1912									
		Upper Lagger, Jur	1930	1,875	4,367,311	87,927						
		Wealden, Cre L	1936									
19	Oberg	Lower Lagger, Jur L	1919	245	321,460	7,516						
		Wealden, Cre L	1932									
20	Steimbke	Eocene, Tert.	1943									
		Valendis, Cre L	1942									
		Wealden, Cre L	1936	165	484,811	59,797				20		
		Serpulit, Jur L	1937									
		Gigas-Beds, Jur L	1949									
21	Stemmerberg	Cornbrash, Jur U	1939									
		Cornbrash, Jur U	1948	Exploration Wells only								
22	Suderbruch	Cornbrash, Jur U	1949	3	3,266	3,366				27		
23	Ihoren	Wealden, Cre L	1941									
		Upper Lagger, Jur	1942	40	147,330	17,042						
24	Wesendorf	Ibhetic, Tri	1946									
		Lower Lagger, Jur L	1943							35		
		Lower Liassic, Jur	1947	110	299,354	57,639						
		Neocomian, Cre L	1948									
25	Wietze	Neocomian, Wealden	1858	405	2,374,655	25,315						
	Niedersachsen (Hannover)	Jurassic, Ibhetic			9,773,096	412,712						
26	Adorf	Wealden, Cre L	1947		4,396	2,043		3.4	0.4			
27	Ehlichsen	Valendis, Cre L	1943	300	279,006	129,937				25		
28	Georgsdorf	Valendis, Cre L	1943	660	236,596	132,109				20		
29	Lingen	Valendis-Weald., Cre L	1942	180	227,703	60,140		9	5	69		
30	Ruhlermoor	Valendis, Cre L	1949	800	829	829				19		
31	Ruhlertwist	Valendis, Cre L	1949	750	384	384						
32	Scheerhorn	Valendis, Cre L	1949	Exploration Wells only	599	599				30		
33	Ihrtheye	Flottenkalkstein, Per	1939				1,300	415	47			
	Niedersachsen (Holland)				749,523	924,940		424	52			
34	Heide	Neocomian, Cre L										
		Upper Permian, Per	1935	400	1,366,415	56,020						
35	Hohenhorn	Lower Lagger, Jur	1949	Exploration Wells only	30	30						
36	Isenbrook	Lower Oligocene, Olig	1910									
		Upper Cretaceous, Cre U	1937	502	1,202,815	41,974	40	40	2			
		Eocene, Eoc L	1943									
	Hamburg/Schleswig-Holstein				2,469,260	98,024		40	2			
37	Forst-Pesher	Lower Lagger, Jur	1935									
		Cyrenenmergel, Eoc	1935	82	76,946	3,191						
		Lagger, Tri	1936									
		Cyrenenmergel, Olig	1937									
38	Reingarten	Meletta Schicht., Oligl	1936	120	81,153	2,719						
	Baden	Pechelbronn. Sch., Oligl	1936		115,069	5,900						
	Bundesrepublik Deutschland				13,106,748	841,576		475.4	54.4			

LINE NUMBER	NUMBER OF WELLS[a]			WELLS PRODUCING[f] DEC. 1949			RESERVOIR PRESSURE LB PER SQ INCH		SECONDARY RECOVERY[g]	CHARACTER OF OIL[h]		PRODUCING FORMATION					DEEPEST ZONE TESTED[n] TO END OF 1949	
	COMPLETED TO END 1949	1949		OIL		GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT[k]	PROD. THICKNESS AVG. FT / NET	STRUCTURE[l]	NAME	DEPTH OF HOLE, FT
		COMPLETED	ABANDONED	FLOWING	ARTIFICIAL LIFT													
1		-			1		-	-		0.85	0.3	S	10-20	846	9	D S		
2	12	3	-		8									750		(M P)	Buntsandstein, Trs	1,040
															6	D S	Zechstein	113
										0.92	0.5	S				U S		
3	17	8	-		8		10			0.86	0.4	S	20	400		U S		875
4	16	-	-		20	2									6	(M P)	Schilfsandstein, Trs	250
										0.95	1.0	S	25	200	14	D S		850
5	56	-	5		13					0.86	0.6	S	?	510	20	D S	Permian, Per	
6	40	-	-		17									1,085	36	D S	Wealden, Cre L	1,402
7	6	-	-		1		130			0.19	0.9	S						
														1,595		A	Middle Muschelkalk, Trs	1,750
8		-	-		1											D S		
																(M P)	Posidon. Sch., Jur	2,065
9	4	-	-		1					0.98	7.0	Ge	F	1,385				
										0.92	0.6	S	25	80	36	D S	Schilfsandst, Trs	1,056
10	132	36	10		151					0.95	1.0	S	25	200	15	D S		300
11	102	-	-		35		5	5		0.90	0.7	S	14-	1,191				
12	21	5			12		143						34	1,343	7	D S	Wealden, Cre L	1,380
															36	D S	Lias Fuhrberg	
13					18					0.92	0.6	S	25	80	30	D S	Rhaetic, Trs	1,183
14	54	2	2	3	43		85	5		0.90	0.7	S	35	668				
															40	A F	Rhaetic, Trs	1,009
15	45	7	3		26	2	50	16	1947	0.87	0.5	O L	33	440	22			
16	80	-	3		32					0.92	1.9	L S	24	300	13	D S	Anhydrite, Per	503
														449				
										0.37				70				
17											0.5	S						
										0.87		O L		300	10	D S	Permian	3,300
														280				
	181	1	15		43		40			0.91		S	20	900	2			
18														250				
										0.91		S	20	800	10			
										0.88		S	30	1,200	15	D S	Rhaetic, Trs	2,159
	1,300	2	-		204					0.97		S	20	1,600				
										0.85	0.3	S	12	118		D S		
19	292	11	2		78	16							35	570	5	(M P)	Rhaetic, Trs	1,100
												(Gly)	?					
20												S	20	240	4	D S		
							22	8				S	18	240-250	4	(M P)		
														600	5		Schilfsandstein, Trs U	1,163
	338	63	-	6	181	1	55	30		0.94	none	O L	25	250		A F		
							77	70				L S	23	510	15			
														766			Cornbrash, Trs	1,203
21																		
22	1	1	-	1	-	-	228	228		0.85	0.8	S	20	2,040	14	A F		600
							5			0.94	0.9	S	25	470	20	D		950
23								30		0.85	0.5	S	20	870	15	D		1,400
	82	5	-		59		100	60		0.84	0.4	S	20	1,220	10	D		1,150
							115	90		0.84	0.4	S	25	850	7	D S		-
24							180	175		0.82	0.2	S	30	1,830	40	D S		
	57	16	2	23	7		40	5		0.96	2.3	S + K	25	300	20	D S		400
															10			
										0.89	0.6				40	D S		1,500
25										0.96	0.9	S	20-25	110				
	2,100	-	15		342													
	5,116	160	93	33	1,290	21				0.87	0.6	L/Sb	P	1,235	60	M F	Trs	1,739
26	1	3	-		1					0.90	0.8	S	35	727	30	A	Portland, Jur	1,154
27	38	28	1		47		80	60		0.91	0.7	S	27	476				
28	103	44	1	69	8		72	67						1,018	36	A F	Serpulit, Jur	1,388
														874	150	A F	Liasmic, Jur	1,592
							100	70		0.87	0.8	S		626	30	A	Dagger, Jur	2,072
29	77	22	1	1	67		75	75		0.37	1.1	S		740	20	A	Wealden, Cre L	1,305
30	2	-	-	1	1		74	74		0.90	1.02	S	30	1,100	22	M U	Wealden, Cre L	1,123
31	3	1	-		-		118	118		0.87	1.15	S	P					
32	1	-	-	1	-									1,548	43	A	Hutlang, Per L	2,546
											0.3	L						
33	7	-	-	-	-	2	170	138							5			
	254	98	3	72	124	2	80	10		0.87	1.0		20	830	10	D S	-	-
34							100	60		0.95	3.0	L S	40	1,627			Zechstein Anhydr. Per	1,724
35	265	14	-		53													
	-	-	-		-									236				
										0.93	2.4	S	25	639	4	D S	Anhydrit, Per	2,952
36	238	7	2		120	10	56	46		0.92			32	645	10			
	503	21	2		173	10												
37										0.85	0.2	S		700	30	M F		
	95	2	2		48					0.86	0.3	S	9	800	7	M F		
										0.86	0.2	S	10	400	20	D		
										0.87	0.2	S	24	400	6	M F		
38	82	4	7		74					0.86	0.2	S/Sb	P	250		T F	Pechelbronner, Olig L	675
													S/Ge	300			Schichten	
	177	6	9		122													
	7,050	385	71	105	1,709	33												

TABLE 2 - SUMMARY OF DRILLING OPERATIONS IN GERMANY

IMPORTANT WILDCATS DRILLED IN 1949

LINE NUMBER	COUNTY OR LOCALITY	LOCATION SEC. TWP. RGE. SURVEY LAT. LONG.	TOTAL DEPTH FT. OR METERS	FORMATION	DEEPEST HORIZON TESTED	DRILLED BY	INITIAL PRODUCTION PER DAY OIL BBL.	GAS MILLION CU. FT.	CONDENSATE U.S. BBL.	CHOKE FRACTIONS OF AN INCH	PRESSURE, LBS. PER SQ. IN. CASING	TUBING	REMARKS
1	Sudetenruh 1	52°41'56" 9°29'31"	2196.3	Quaternary	Cornbrash (Dogger)	Gewerkschaft-Brigitta	170	-	-	1/8"	711	625	Discovery well
2	Bodewald BA(H)	52°39'43" 9°23'10"	1785.9	Quaternary	Drilling	Gewerkschaft-Brigitta							Will test Zechst.
3	Seldorf BB	54°5'00" 9°1'48"	1302 m	Alluvium	Lower Cretaceous	Deutsche Erdöl A.G.	102	-	-	-	0 atu	-	Disc. new field
4	Soiseerhorn 1	52°34'44" 7°1'21"	1123.5	Diluvium	L. Cret. Valend.	Lehmann	300	-	-	5 mm	-	-	Productive
5	Kuhlenberg 2	52°5'52" 10°05'41"	1210.5	Diluvium	Wealden	Elwerath	260	-	-	1/6"	355	341	Production test
6	Steinwedel 1	52°24'16" 10°01'08"	2153.4	Diluvium	Lower Cretac.	Elwerath							Dry
7	Eldingen 1	52°48'09" 10°26'10"	1750.6	Diluvium	Rhaetic	Elwerath							Dry
8	Eldingen 2	52°49'49" 10°22'46"	1636.0	Diluvium	Rhaetic	Elwerath							Dry
9	Stemmerberg 5	52°30'58" 9°31'05"	1090.8	Diluvium	Cornbrash	Elwerath							Dry
10	Stemmerberg 6	52°30'17" 9°31'33"	884.2	Diluvium	Lower Cretac.	Elwerath							Dry
11	Stemmerberg 7	52°21'01" 9°31'58"	626.5	Diluvium	Dogger	Elwerath							Dry
12	Stemmerberg 8	52°31'16" 9°31'24"	730.0	Diluvium	Dogger	Elwerath							Dry
13	Hameln 2	52°07'56" 9°22'52"	2186.0	Hunter	Carboniferous	Elwerath							Dry
14	Holenteich 5	52°46'36" 10°43'08"	1707.5	Diluvium	Middle Keuper	Elwerath							Dry
15	Isenhorn 2	52°14'03" 10°34'06"	419.0	Diluvium	Liassic	Elwerath							Dry
16	Isenhorn 2	52°16'32" 10°29'10"	804.5	Diluvium	Dogger	Elwerath							Dry
17	Isenhorn 3	52°18'39" 10°29'12"	778.0	Diluvium	Dogger	Elwerath							Dry
18	Isenhorn 36	52°43'15" 9°06'39"	1324.2	Diluvium	Zechstein	Elwerath							Dry
19	Hohenhorn 11	53°29'10" 10°21'49"	1724.0	Diluvium	Zechsteinanhydr.	Elwerath	90						Production test
20	Hohenhorn 12	53°28'46" 10°25'10"	838.3	Diluvium	Zechsteinanhydr.	Elwerath							Dry
21	Lilienthal 1	53°00'18" 9°26'38"	1462.0	Diluvium	Zechstein salt	Elwerath							Dry
22	Quickborn 2	53°41'37" 9°57'30"	1367.4	Diluvium	Keuper	Elwerath							Dry
23	Barbarit 3	53°35'53" 7°40'34"	1550.0	Diluvium	Gipskeuper	Elwerath							Dry
24	Salzbergen 2	52°19'29" 7°22'19"	1746.4	Diluvium	Carboniferous	Elwerath							Dry hole
25	Oelossa 5	52°31'42" 10°41'38"	605.0	Diluvium	Dogger B	Itag							Dry hole
26	Hanel 4	52°48'30" 10°32'30"	2064.2	Diluvium	Wittierer Muschelkalk	Itag							Dry hole
27	Ost 2	49°14'37" 8°38'24"	664.5	Oligozän	Schilfsandst.	Itag							Dry hole
28	Itag Baden 117	49°10'11" 8°31'58"	655.2	Diluvium	oberer Muschelkalk	Itag							Dry
29	Etzel 23	53°36'50" 7°56'15"	1406.-	Diluvium	Dogger gamma	Preussag							Dry
30	Schale 2	52°34'10" 7°39'50"	205.7	Diluvium	Portland	Preussag							Dry
31	Voltlage 1	52°26'26" 7°43'18"	143.6	Diluvium	Lias alpha	Preussag							Dry
32	Voltlage 2	52°27'06" 7°43'15"	247.5	Diluvium	Lower Trias	Preussag							Dry
33	Lintorgen 1	52°26'50" 7°47'03"	440.2	Diluvium	Permian Rotliegs.	Preussag							Dry
34	Vorsfort 4	52°21'51" 10°31'08"	1005.0	Diluvium	Lias alpha	Preussag							Dry
35	Vorsfort 5	52°21'51" 10°31'08"	702.1	Diluvium	Upper Trias	Preussag							Dry hole aband.
36	Falte-Nordrand	52°43'01" 9°30'30"	1402.0	Quaternary	Valendis	D.V.O.A.G.							Productive
37	Bühlerwust 2	52°38'06" 7°5'63"	781.2	Diluvium	L. Cret., Wealden	Wintershall	60						Dry Hole
38	Felmdorf 1	52°46'5" 7°9'30"	1830.8	Diluvium	L. Cret., Wealden	Wintershall							

	IN PROVEN FIELDS	WILDCATS
Number of wells drilling, Dec. 31, 1949	38	24
Number of wells completed during 1949	285	67
Number of gas wells completed during 1949	-	-
Number of dry holes completed during 1949	76	55

Oil And Gas Developments In Iran During 1949

By ANGLO-IRANIAN OIL COMPANY, LTD.

ABSTRACT

CRUDE PRODUCTION

• Masjid-i-Sulaiman	2,696,000 long tons
Lali	396,000 long tons
Haft Kel	9,909,000 long tons
Naft Safid	1,038,000 long tons
Agha Jari	11,169,000 long tons
Gach Saran	1,959,000 long tons
• Naft-i-Shah	145,000 long tons
	26,807,000 long tons

• Both net production, excluding recycled products.

SULPHUR RECOVERY

Masjid-i-Sulaiman	11,000 long tons
Abadan	3,000 long tons
	14,000 long tons

GENERAL

Masjid-i-Sulaiman - No new wells have been drilled. Recycling of products to the reservoir was resumed during the year.

Lali - This field has been on production throughout the year. Drilling for production and reservoir control continues.

Haft Kel - There have been no developments of special interest during the year.

Naft Safid - Two new producers have been completed and drilling up of the structure continues.

Agha Jari - Fields potential has been increased by the completion of two new producers. During the year additional production plant and pipeline facilities were installed, and the rate of offtake was stepped up from 75 to over 100 million bbl per annum.

Gach Saran - The area has been on continuous production from three wells.

Naft-i-Shah - Production has continued to supply local market requirements in northwest Iran. Recycling of products to the reservoir continues.

Ahwaz - Exploratory drilling in progress.

CRUDE PRODUCTION FROM FIELDS

	1948		1949[a]	
	LONG TONS	BARRELS[b]	LONG TONS[c]	BARRELS[d]
Masjid-i-Sulaiman[e]	3,313,246	25,773,600	2,696,000	21,105,000
Lali	387,688	2,961,700	396,000	3,020,000
Haft Kel	9,790,464	75,737,400	9,404,000	72,673,000
Naft Safid	164,506	1,246,800	1,038,000	7,833,000
Agha Jari	9,093,399	68,752,500	11,169,000	84,315,000
Gach Saran	1,980,942	14,779,800	1,959,000	14,607,000
Naft-i-Shah[e]	140,813	1,131,700	145,000	1,159,000
Totals	24,871,058	190,383,500	26,807,000	204,712,000

a - Provisional and may be subject to correction
b - To nearest 100 bbl
c - To nearest 1,000 tons
d - To nearest 1,000 bbl
e - Net Production, i.e. excluding recycled products

SULPHUR RECOVERY

The total amount of sulphur produced during the year at the sulphur recovery plants was 14,000 tons, of which 11,000 tons were produced at Masjid-i-Sulaiman and 3,000 tons at Abadan.

MANUSCRIPT RECEIVED IN THE OFFICE OF THE INSTITUTE, MAY 1950.

TABLE I - OIL AND GAS PRODUCTION STATISTICS FOR IRAN DURING 1949

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION AREA PROVED ACRES	OIL PRODUCTION BARRELS TO END OF 1949	OIL PRODUCTION BARRELS DURING 1949	GAS PRODUCTION AREA PROVED ACRES	GAS PRODUCTION MILLION CU FT[c] TO END OF 1949	GAS PRODUCTION MILLION CU FT[c] DURING 1949	GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl TO END OF 1949	CONDENSATE PRODUCTION Thousands of Bbl DURING 1949
1	Agha Jari	Asmari, Olig, Mio	1937-1938	23,000	247,469,000	84,315,000						
2	Gach Saran	Asmari, Olig, Mio	1929-1937	30,800	105,229,000	14,607,000						
3	Haft Kel	Asmari, Olig, Mio	1938	29,000	897,995,000	72,873,000						
4	Lali	Asmari, Olig, Mio	1938	4,000	6,000,000	3,020,000						
5	Masjid-i-Sulaiman	Asmari, Olig, Mio	1908	34,500	840,140,000	21,105,000						
6	Naft-i-Shah	Kalhur, Olig, Mio	1923	3,840	11,935,000	1,159,000						
7	Naft Safid	Asmari, Olig, Mio	1936-1938	13,000	21,826,000	7,833,000						
8	Paraman	Asmari, Olig, Mio	1937				6,400	120,000	Nil		6,500,000	Nil

[f] Provisional

TABLE I - OIL AND GAS PRODUCTION STATISTICS FOR FRANCE AND FRENCH OVERSEAS TERRITORIES

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION AREA PROVED ACRES	OIL PRODUCTION BARRELS TO END OF 1949	OIL PRODUCTION BARRELS DURING 1949	GAS PRODUCTION AREA PROVED ACRES	GAS PRODUCTION MILLION CU FT[c] TO END OF 1949	GAS PRODUCTION MILLION CU FT[c] DURING 1949	GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl TO END OF 1949	CONDENSATE PRODUCTION Thousands of Bbl DURING 1949
1	Saint Marcet	Cre L, Jur	1939		37,250	2,750	2,000 (Approx.)	34,000	8,425		53,300	16,300
2	Pechelbronn	Olig, Jur, Tri	1735 (Olig)		19,750,000	411,500	x	x	x	x	x	x
			1922 (Jur) 1933 (Tri)		8,000							
	D. O. T. French Morocco											
1	Oued Beth	Pennsre	1942		230,000	125,000	x	x	x	x	x	x
2	Ain Hamra	Tho	1918	800	63,000	4,450	x	x	x	x	x	x
3	Tselfat	Jur, Tri	1934	130	90,000	2,650	x	x	x	x	x	x
	Algeria											
1	Oued Guterins	Eoc	1949		2,000	2,000	x	x	x	x	x	x
2	Tliouanet	Mio	1914		230,000	x	x	x	x	x	x	x

LINE NUMBER	NUMBER OF WELLS[e] COMPLETED TO END 1949	1949 COMPLETED	1949 ABANDONED	WELLS PRODUCING[f] DEC. 1949 OIL FLOWING	OIL ARTIFICIAL LIFT	GAS	RESERVOIR PRESSURE LB PER SQ INCH INITIAL	RESERVOIR PRESSURE LB PER SQ INCH AVG./END 1949	SECONDARY RECOVERY[g]	CHARACTER OF OIL[h] GRAVITY A.P.I.	CHARACTER OF OIL[h] SULPHUR PER CENT	PRODUCING FORMATION CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT.[k]	PROD. THICKNESS AVG. FT NET	STRUCTURE[m]	DEEPEST ZONE TESTED[n] TO END OF 1949 NAME	DEEPEST ZONE TESTED[n] TO END OF 1949 DEPTH OF HOLE, FT
1	23	2		15			1,960	1,760		35.6	1.4	L	F	4,500	600	A	Asmari	
2	15	Nil		3			1,900	1,840		32.8	1.6	L	F	2,300	1,500	A	Asmari	
3	48	Nil		30			1,070	600		39.2	1.2	L	F	2,000	900	A	Asmari	
4	11	2		2			1,700	1,650		35.3	0.9	L	F	3,900	1,300	A	Cretaceous	
5	258	Nil		29			630	-20		38.0	1.0	L	F	600	1,000	A	Eocene	
6	6	Nil		1			1,660	1,420		42.8	0.7	L	F	2,400	250	A	Kalhur	
7	14	2		3			1,600	1,530		35.8	1.5	L	F	3,000	900	A	Asmari	
8	4	Nil				Nil	3,370	3,370		66.7	0.15	L	F	5,500	700	A	Asmari	

[e] Includes

[f] Referred to mean sea level

(1) Wells used for
(a) Production
(b) Recycling of Products
(c) Observation of Reservoir Pressures and Fluid Levels
(2) Abandoned Wells
(3) Dry Holes

R. H. DESAINT

LINE NUMBER	NUMBER OF WELLS[e] COMPLETED TO END 1949	1949 COMPLETED	1949 ABANDONED	WELLS PRODUCING[f] DEC. 1949 OIL FLOWING	OIL ARTIFICIAL LIFT	GAS	RESERVOIR PRESSURE LB PER SQ INCH INITIAL	RESERVOIR PRESSURE LB PER SQ INCH AVG./END 1949	SECONDARY RECOVERY[g]	CHARACTER OF OIL[h] GRAVITY A.P.I.	CHARACTER OF OIL[h] SULPHUR PER CENT	PRODUCING FORMATION CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT.[k]	PROD. THICKNESS AVG. FT NET	STRUCTURE[m]	DEEPEST ZONE TESTED[n] TO END OF 1949 NAME	DEEPEST ZONE TESTED[n] TO END OF 1949 DEPTH OF HOLE, FT
1	24	4	1	x	x	15	2,050			45		Cr-L		5,000	500	A	Triassic	10,000
2	2,490	56	10	2	700	x	x			32		S-L		600-3,000	x	M F	Triassic and Gravite	6,000
1	97	43	11	15	x	x		x		34		L		2000-3000	x	F	Primary bed	5,000
2	102	x	x	x	18	x		x		45		S		500	10	A F	Cretaceous, Triassic	
3	80	x	x	x	1	x		x		41		S		600			Triassic	
1	9	8	1	x	x	x		x		45		S		1,000	30	A	Cretaceous	3,000
2				x	x	x		x										

TABLE 2 - SUMMARY OF DRILLING OPERATIONS IN FRANCE AND OVERSEAS TERRITORIES

IMPORTANT WILDCATS DRILLED IN 1949

LINE NUMBER	COUNTY OR LOCALITY	LOCATION SEC. TWP. RGE. SURVEY LAT. LONG.	TOTAL DEPTH M.	FORMATION	DEEPEST HORIZON TESTED	DRILLED BY	INITIAL PRODUCTION PER DAY OIL U.S. BBL. GAS MILLION CU. FT. CONDENSATE U.S. BBL.	CHOKE FRACTION OF AN INCH	PRESSURE LBS. PER SQ. IN. CASING	PRESSURE LBS. PER SQ. IN. TUBING	REMARKS
1	Plagne	Haute Garonne	3,250	Cre U	Tri	Regie Autonome des Petrole					Dry (gas shows)
2	Castillon	Haute Garonne	2,791	Cre L	Tri	Regie Autonome des Petrole					Dry
3	Audignon	Landes	2,953	Cre U	Tri	Societe Nationale des Petroles d'Aquitaine					Dry
4	Gerlan	Hautes Pyrenees	3,169	Cre U	Tri	Societe Nationale des Petroles d'Aquitaine					Dry (oil shows)
5	Vauvert	Gard	3,422	Cre U	Jur	Societe Nationale des Petroles					Dry (gas shows)
6	Gaillargues	Herault	1,702	Mio	Lev	Mediterranean					Oil Prod. Test
7	Saint Jean Narbonnais	Gard	1,968	Mio	Cre U						Oil Prod. Test
8	Soultz 1	Bas Rhin	865	Olig	Tri	Pechelbronn S.A.E.M.	500	1/6			Oil & gas in Tri.
9	Soultz 2	Bas Rhin	849	Olig	Tri	"	30				Oil & gas in Tri.
10	Kenitra	French Morocco	2,173	Quat	Primaire	Societe Chaffaronnelles Petroles					Gas shows
11	Oued Beht	French Morocco	3,752	Quat	Jur	"					Dry
12	El Menzeh	French Morocco	1,655	Quat	Cre L	"					Gas shows
13	Oued Hamma	French Morocco	2,501	Quat	Jur	"					Dry
14	El Rhod	Algeria	2,241	Pli	Mio						Gas shows
15	Akkaiche	Algeria	2,014	Pli	Olig						Dry (Oil shows)
16	Fekka	Algeria	2,116	Pli	Mio						Dry
17	Oued Gueterun	Algeria	910	Mio	Cret U	Societe des Petroles	70				Oil discovery in Eocene
18	Cap Bon	Tunisia	3,337	Eoc	Jur	Societe des Recherches et d' Exploitation des Petroles en Tunisie					Gas Prod. Test
19	El Haouaria	Tunisia	2,857	Eoc	Cre U						Dry
20	Mahoro	French Equitorial Africa	3,189	Cret U	Cre L	Societe des Petroles d'A.E.F.					Dry

	IN PROVEN FIELDS	WILDCATS
Number of wells drilling Dec. 31, 1949	20	37
Number of wells completed during 1949	65	113
Number of gas wells completed during 1949	4	1
Number of dry holes completed during 1949	26	98

Oil And Gas Developments In Kuwait During 1949

By KUWAIT OIL COMPANY, LTD.

Development of the Burgan Field continued throughout 1949. Forty-nine wells were completed during the year, bringing the number of completed wells up to 86, with 61 wells actually producing and the remaining wells awaiting connection to gathering centers.

Twelve drilling rigs were in operation during the year with an average cycle period of 80 days per well, while the average time per well from spudding-in to completion was 65 days. The total footage drilled during the year was 246,733 ft.

In August drilling was commenced on a deep test well for the purpose of exploring the horizons below the present Burgan producing series. A special heavy type rig is being used for this drilling. Twenty-inch casing was set at 644 ft and 13 3/8-inch casing at 3,576 ft.

Production from the Burgan wells was obtained from three zones between 3,500 and 4,800 ft and the total quantity of crude oil received into the Ahmadi storage tanks was 89,930,444 bbl for the year.

The crude oil collected from the wells passes through four gathering centers having a total capacity of approximately 410,000 B/D. Two of these gathering centers were commissioned during the year, one in January and one in May, while the construction of a fifth gathering center is nearing completion. It is planned that each gathering center will have a capacity of approximately 100,000 B/D.

From the gathering centers the oil is pumped to the tank farm at Ahmadi 10 miles distant by means of two 20-inch transit lines.

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During 1949 five further tanks of 168,000 bbl capacity were put into commission for oil storage in the Ahmadi Tank Farm. The total tankage now consists of nine 168,000 bbl and six 139,000 bbl tanks. A further six 168,000 bbl tanks are in course of erection and these will bring the total storage capacity of the tank farm up to 3,018,600 bbl.

In addition to the above tanks erected at Ahmadi three 168,000 bbl tanks were constructed during the year under review at Mena Al Ahmadi. Two of these tanks have been allocated to the storage of distillate and furnace oil and the third to crude oil for export in conjunction with the loading pumphouse.

The export of crude is effected through five gravity lines, 2-22-inch dia. and 3-24-inch dia. each approximately 6 1/4 mi long, which run from the tank farm to the oil loading jetty at Mena al Ahmadi; the last three of these lines (24-inch) were commissioned during 1949.

The original submarine loading lines to the tanker berths have now been replaced by the new oil jetty which was commissioned in November 1949. This jetty comprises an approach pier 4,140 ft long carrying a 24 ft roadway and 35 ft pipeway and a T head for the oil and cargo jetties. The oil head, 2,805 ft long by 105 ft wide, provides berths for six tankers to load simultaneously and has a designed export capacity of 500,000 B/D.

The cargo head 1,076 ft long by 100 ft wide provides berths for two cargo ships.

A total of 803 tankers was loaded in 1949 and 88,643,985 bbl of crude oil and 103,105 bbl of distillate were exported from Kuwait during the year.

The Topping Plant and Refinery for the processing of crude oil for bunker oils and local products was commissioned in November. The capacity of this plant is 25,000 B/D.

TABLE I - OIL AND GAS PRODUCTION STATISTICS FOR KUWAIT DURING 1949

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION: AREA PROVED ACRES	OIL PRODUCTION: BARRELS TO END OF 1949	OIL PRODUCTION: BARRELS DURING 1949	GAS PRODUCTION: AREA PROVED ACRES	GAS PRODUCTION: MILLION CU. FT.[c] TO END OF 1949	GAS PRODUCTION: MILLION CU. FT.[c] DURING 1949	GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION (Thousands of Bbl.): TO END OF 1949	CONDENSATE PRODUCTION (Thousands of Bbl.): DURING 1949
1	Burgan, Kuwait	Middle Cretaceous (Cre. M)	1938	32,000	158,633,124	89,930,444	32,000	79,708	44,764	501	-	-

DEVELOPMENTS IN KUWAIT DURING 1949

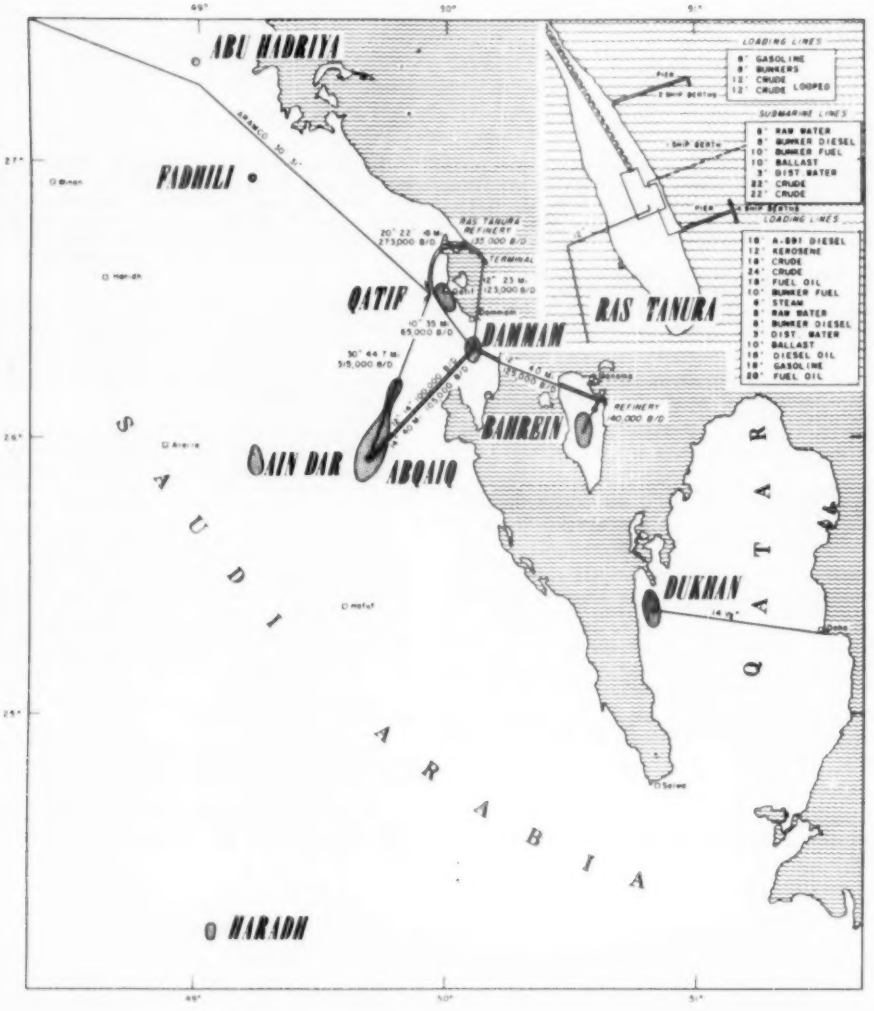

FIG. 1—PETROLEUM FACILITIES, SAUDI ARABIA, BAHREIN AND QATAR

KUWAIT OIL COMPANY, LTD.

LINE NUMBER	NUMBER OF WELLS[d]			WELLS PRODUCING[f] DEC. 1949			RESERVOIR PRESSURE LB PER SQ INCH		SECONDARY RECOVERY[g]	CHARACTER OF OIL[h]		PRODUCING FORMATION					DEEPEST ZONE TESTED[n] TO END OF 1949	
	COMPLETED TO END 1949	1949		OIL		GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT[k]	PROD. THICKNESS AVG. FT[l] NET	STRUCTURE[m]	NAME	DEPTH OF HOLE, FT
		COMPLETED	ABANDONED	FLOWING	ARTIFICIAL LIFT													
1	86	49	Nil	61	Nil	-	2,080	2,057		31·6	2.5	S & a'stone	30	3,900	470	A f	Lower Cretaceous (Cre. L)	5,002

Oil And Gas Developments In Peru During 1949

Petroleum production in Peru during 1949 totaled 14,796,092 bbl amounting to 40,537 B/D, a peak production figure during the years since 1938. The figure also represents a five per cent increase over the 1948 figure. The Ganzo Azul Field of the Montana region is the only producing area in the report outside the Northwest Coastal area. International continued as the leading producer, accounting for a large part of the 1949 increase in production. No significant new reserves were noted.

Foreign companies without established production have been caused to leave Peru due to the absence of an adequate petroleum law. Consequently, International was the sole organization continuing with surface exploration work which centered in the Montana area. The company also carried on work on the La Brea-Parinas Estate. Only eight party months were spent on the field.

In 1949, one-hundred sixty-six exploitation and 26 exploration wells were completed. International completed eight of 25 exploration wells. Of these completions, a few are marginal producers and are not considered as having revealed commercial reserves. Of the commercial reserves discovered, all are field extensions in fault blocks adjacent to producing areas. At the end of 1949, there was no exploration drilling taking place in Peru.

Legislation of special interest to the exploration branch of the industry may be summarized as follows:

1. Decree of January 30th 1949

Obligated all entities who had done work of ageodetic, astronomic, topographic, photogrammetric and aerial photographic nature to give a copy of their work to the government. A copy of the calculations and description of the work was also required.

2. Supreme Decrees and Resolutions of September 15th

These were issued in an attempt to clarify and liberalize the country's petroleum policy.

As of that date the office of "Director de Petroleo" was formed within the Ministry of Fomento. The Empresa Petrolera Fiscal, since April 2nd, 1948, was made a direct dependency of the Ministry of Fomento under the Director of Petroleum.

Supreme Resolution No. 6 of September 15th, attempted to attract foreign capital and encourage exploration by authorizing the Ministry of Fomento to grant permits to conduct exploration work in "free areas." As this would exclude national reserves it applied essentially to Sierra and Montana zones. Articles 5 and 6 of this decree authorized the government to appoint a representative to observe both field and office work and required the submission of reports, maps, etc. on work done under the decree. These articles were liberalized by Supreme Resolution No. 24 of November 3rd which stated that an observer would only be appointed for work within 50 kms. of the international boundary and that reports could not be requested before three years had elapsed after the completion of the work.

3. Proposed New Petroleum Law

A proposed new petroleum law was made public by publication in the press December 1, 1949. At the time of writing this law has not been promulgated and it is considered likely that no action will be taken on it before Congress meets which will not be before the second half of the year. The proposed law divides the country into four zones: Continental Shelf, Coastal, Sierra and Oriente (Montana) for which there are different regulations as to concessions, royalty, taxes, etc. Some features of the law are tabulated below:

EXPLORATION	COASTAL	SIERRA	ORIENTE
Maximum size of Concession (Hectares)	60,000	80,000	200,000
Initial Period (Years)	4	5	6
Extension Period (Years)	2	4	5
Refundable Guarantee Deposit (soles per Hectare)	3.00	1.00	0.50
Annual taxes for Hec. (Soles)			
Initial Period	2.00	1.00	0.20
Extension Period	4.00	2.00	0.40
Exploitation			
Maximum size of Concessions (Hectares) - (Not to exceed one half of Exploration concession from which they are derived)	30,000	40,000	100,000
Duration			
Initial Period (Years)	40	45	50
Extention Period (Years)	20	25	25
Initial Fee (Soles per hec.)	25.00	12.50	6.25
Annual Texes for Hec. (Soles)			
First 10 years	5.00	2.50	1.25
Third 5 years	10.00	5.00	2.50
Fourth 5 years	15.00	7.50	3.75
Fifth 5 years	20.00	10.00	5.00
Thereafter	25.00	12.50	6.25
Royalty	12½%	6%	3%

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Additional features of interest are:

1. Concessions must be rectangular and the ratio of the smaller to greater dimension must not exceed 1:4.
2. There are no work obligations except as forced indirectly by taxes and the length of exploration period.
3. Technical reports including geological and geophysical may be requested for work done on concessions.
4. Exploration work is permitted in areas not covered by concessions and National Reserves.
5. Practically no surveying is required for exploration concessions.
6. Concessions on the continental shelf may be obtained under unspecified terms but they may be less favorable to the State than the terms for the coastal zone.
7. Concessions on National Reserve lands may be obtained under special terms which in no case may be less favorable for the State than those specified in the law for the zone in which the National Reserves fall.
8. There is no limit to the number of exploration or exploitation concessions that may be held by any one entity.

CRUDE PRODUCTION

COMPANY	CUMULATIVE TO DEC. 31, 1949	1948 TOTAL	1948 DAILY AVERAGE	1949 TOTAL	1949 DAILY AVERAGE
International Petroleum Co. Ltd. La Brea Parinas Estate	312,015,398	11,362,498	31,045	11,912,964	32,638
Compania Petrolera Lobitos Lobitos, El Alto and Los Organos	69,975,161	2,472,969	6,757	2,621,779	7,183
Empresa Petrolera Fiscal Zorritos and Los Organos	4,402,050 *	112,603	308	121,152	332
Compania Ganzo Azul Aguas Calientes	649,483	120,810	330	140,197	384
Total Peru	387,042,092	14,068,880	38,440	14,796,092	40,537

* Includes 286,644 bbl from the abandoned Pirin Field.

SURFACE EXPLORATION

	1948	1949
Geological	68	31
Seismograph	12	23
Gravity	12	
Total	92	54

DRILLING

EXPLOITATION

COMPANY	1948 O	1948 G	1948 D	1948 Total	1949 O	1949 G	1949 D	1949 Total
Northwest Coastal Zone								
International	67	3	21	91	72	1	27	100
Lobitos	45	0	2	47	59	1	2	62
E.P.F.	3	0	0	3	1	0	3	4
Total Exploitation	115	3	23	141	132	2	32	166

EXPLORATION

Northwest Coastal Zone								
International	10	2	19	31	8	1	16	25
Eastern Peru (Montana)								
Cia. "El Oriente"	0	0	0	0	0	0	1	1
E.P.F.	0	0	1	1	0	0	0	0
Total Exploration	10	2	20	32	8	1	17	26
Grand Total	125	5	43	173	140	3	49	192

TABLE I - OIL AND GAS PRODUCTION STATISTICS FOR PERU IN 1949

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO[c] MCF/BBL	CONDENSATE PRODUCTION[1] Thousands of Bbl	
				AREA PROVED ACRES	BARRELS TO END OF 1949	BARRELS DURING 1949	AREA PROVED ACRES	MILLION CU FT[c] TO END OF 1949	MILLION CU FT[c] DURING 1949		TO END OF 1949	DURING 1949
1	International Petroleum Co. Ltd., La Brea Parinas Concession	Verdun Parinas Eoc. Salina	1869	28,000	312,015,398	11,912,964	1,245	x	12,957	1,088	0	0
2	Compania Petrolera Lobitos Lobitos & Restin-El Alto	Cabo Blanco Eoc. Lower Caverno	1901	17,750	69,975,161	2,621,779	x	x	x	x	0	0
3	Genaro Aual Agua Caliente	Agua Caliente, Cre U	1939	1,000	664,083	140,196	x	x	x	x	0	0
4	Empresa Petrolera Fiscal Los Organos & Zorritos	Zorritos, Mio Heath, Olig Cabo Blanco, Eoc	1860	700	4,262,793 4,109,250 261,926	121,152	x	x	x	x	0	0
5	Government of Peru Pirin	Oroya, Cre L	1906	200	286,644	None	x	x	None	x	0	0

(1) There is no true condensate production in Peru. The production reported in past years has referred to the manufacture of casinghead gasoline by compression of wet gas.

LINE NUMBER	NUMBER OF WELLS[e]			WELLS PRODUCING[f] DEC. 1949			RESERVOIR PRESSURE LB PER SQ INCH		SECONDARY RECOVERY[g]	CHARACTER OF OIL[h]		PRODUCING FORMATION					DEEPEST ZONE TESTED[n] TO END OF 1949	
	COMPLETED TO END 1949	1949		OIL		GAS	INITIAL	AVG./END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT[k]	PROD. THICKNESS AVG. FT / NET	STRUCTURE[m]	NAME	DEPTH OF HOLE, FT
		COMPLETED	ABANDONED	FLOWING	ARTIFICIAL LIFT													
1	4,049	125	x	225	1,975	5	900	350		37.7	None	S	20	2,000	200	F	Pennsylvanian	5,388
2	1,337	62	x		971	(2) x	x	x		36.2	x	S	P	2,000	150	F	Eocene	6,561
3	9	None	None	6	None	None	x	x		43	x	S	P	800	170	D	Pennsylvanian	3,130
4	484	4	x	x	59	None	x	x		41	x	S	P	1,300	25	F	Eocene	3,051
5	28	None		None	None	None	x	x		36.5	x	L	x	4002	x	A F	x	

(2) This figure includes some flowing wells.

TABLE 2 - SUMMARY OF DRILLING OPERATIONS IN PERU DURING 1949

IMPORTANT WILDCATS DRILLED IN 1949

LINE NUMBER	LOCALITY / WELL	LOCATION: TWP.	LOCATION: RGE.	LOCATION: LAT / LONG.	TOTAL DEPTH, FT. OR METERS	FORMATION	DEEPEST HORIZON TESTED	DRILLED BY	INITIAL PRODUCTION PER DAY: OIL, U.S. BBL.	INITIAL PRODUCTION PER DAY: GAS, MILLIONS CU. FT.	INITIAL PRODUCTION PER DAY: CONDENSATE U.S. BBL.	CHOKE, FRACTIONS OF AN INCH	PRESSURE, LB. PER SQ. IN.: CASING	PRESSURE, LB. PER SQ. IN.: TUBING	REMARKS
1	3983 La Brea Parinas Conc.			4°15'16.81"S 81°15'49.56"W	4,562	Pozo	Salina	I. P. C.	256			1/4	1,008	304	Esc-Manta Pool
2	4010 La Brea Parinas Conc.			4°30'43.12"S 81°14'18.09"W	3,132	Verdun	Parinas	I. P. C.		6.35		2			
3	4025 La Brea Parinas Conc.			4°28'33.35"S 81°13'24.66"W	4,871	Verdun	Parinas	I. P. C.	378			1/4	1,430	516	Esc-Arenal Pool
4	4040 La Brea Parinas Conc.			4°35'25.91"S 81°12'41.84"W	2,765	Talara Sandstone	Pale Gredo	I. P. C.	75			Pumping			
5	4045 La Brea Parinas Conc.			4°34'54.76"S 81°09'34.91"W	5,588	Pozo	Amotape Slate	I. P. C.							Dry

	IN PROVEN FIELDS	WILDCATS
Number of wells drilling Dec. 31, 1949	4	0
Number of wells completed during 1949	100	25
Number of gas wells completed during 1949	1	1
Number of dry holes completed during 1949	27	16

Oil And Gas Developments In Trinidad During 1949

By P. E. T. O'CONNOR, B.Sc.

Production of petroleum in Trinidad during 1949 was 20,693,334 bbl as compared with 20,202,253 bbl in 1948.

A total of 142 wells, excluding wildcats, was completed during the year. Of these, 130 were productive and 12 were dry holes.

At year's end there were 2,304 wells on production, of which 655 were flowing and 1,649 were on artificial lift.

One of the major developments during the year has been the southern extension of the Penal-Barrackpore pool where deep Herrera sands have been encountered between 8,000 ft and 10,000 ft.

Exploration was actively carried on in the southeast area of the Island where several deep wells were drilled. While no new pools have been discovered to date, the exploration program in this area continues to be active.

The drilling depth record was surpassed during the year when an exploration well located at Otaheite was drilled to 12,161 ft and abandoned as a dry hole.

Significant developments during the year were the introduction of oil base drilling mud, and the introduction by the Schlumberger Company of induction logging for use in this mud.

MANUSCRIPT RECEIVED IN THE OFFICE OF THE INSTITUTE, JUNE, 1950.

The introduction of oil base mud has proved to be highly successful in overcoming the hazards of caving formation. One well at Barrackpore was drilled from the conductor shoe at 1,050 ft to 10,018 ft in steeply dipping crushed shales carrying oil base mud. This is claimed to be the longest open hole section ever drilled in Trinidad.

Another significant development has been the introduction of diamond coring equipment for the first time. Highly satisfactory results are claimed to have been obtained with this equipment in the coring of fractured rocks, and recoveries of 96 per cent have been obtained as compared with 65 per cent and 22 per cent in similar rocks with conventional equipment.

REFINING

The refineries at Point-a-Pierre and Point Fortin, operated by Trinidad Leaseholds Limited and United British Oilfields of Trinidad Limited respectively, continue to handle the bulk of the Colony's crude.

The Point-A-Pierre refinery has a total crude charging capacity of 75,000 B/D with a cracking capacity of 50,000 B/T. Daily crude runs at the end of 1949 were 60,000 bbl.

The Point Fortin Refinery has a charging capacity of 30,000 B/D, and was running 25,000 B/D at end of 1949.

TABLE I - OIL AND GAS PRODUCTION STATISTICS FOR TRINIDAD, BWI IN 1949

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl	
				AREA PROVED ACRES	BARRELS		AREA PROVED ACRES	MILLION CU FT[c]				
					TO END OF 1949	DURING 1949		TO END OF 1949	DURING 1949		TO END OF 1949	DURING 1949
1	Brighton	Forest, Mio Nariva, Olig	1908	x	x	635,019	x	x				
2	Forest Reserve Apex, San Francique	Forest, Mio Cruse, Mio	1911	x	x	8,234,794	x	x				
3	Guayaguare	Forest, Mio	1902	x	x	338,778	x	x				
4	Kern, Parrylands Cruse	Forest, Mio Cruse, Mio	1913	x	x	3,318,853	x	x				
5	Palo Seco Los Bajos	Forest, Mio Cruse, Mio	1908	x	x	822,221	x	x			NIL	
6	Penal, Barrackpore	Wilson, Mio Herrera, Olig	1938	x	x	3,369,158	x	x				
7	Point Fortin	Forest, Mio Cruse, Mio	1908	x	x	835,238	x	x				
8	Quarry, Coora Quinam Morne, Diablo	Forest, Mio Cruse, Mio	1936	x	x	3,040,283	x	x				
		Totals				20,693,334						

LINE NUMBER	NUMBER OF WELLS[e] COMPLETED TO END 1949	1949 COMPLETED	1949 ABANDONED	WELLS PRODUCING[f] DEC. 1949 OIL FLOWING	OIL ARTIFICIAL LIFT	GAS	RESERVOIR PRESSURE LB PER SQ INCH INITIAL	AVG./END 1949	SECONDARY RECOVERY[g]	CHARACTER OF OIL[h] GRAVITY A.P.I.	SULPHUR PER CENT	PRODUCING FORMATION CHARACTER[i]	POROSITY PER CENT[j]	DEPTH TO TOP OF PRODUCING ZONE FT.[k]	PAY THICKNESS AVG. FT. NET	STRUCTURE[l]	DEEPEST ZONE TESTED[m] TO END OF 1949 NAME	DEPTH OF HOLE, FT.
1				45	45		x	x		16° to 18°						F A	Cretaceous	7,500
2				197	740		x	x		14.8 to 33						A	Oligocene	10,000
3				15	55		x	x		15 to 43						A F	Cretaceous	8,000
4				107	288		x	x		13 to 30						M C A	Lower Cruse	4,000
5				42	217	x	x	x		16 to 33						A M	Herrera, Olig	+10,000
6				98	164		x	x		16 to 30						F A	Herrera, Olig	10,000
7				50	11		x	x		16 to 30						F A	Lower Cruse	x
8				101	169		x	x		16 to 30						A M	Lower Cruse	x
				665	1,649													

Oil And Gas Developments In Venezuela During 1949

By D. C. PORTERFIELD*

Venezuelan production during 1949 was down 1.6 per cent from the peak year 1948 to a total of 482,339,000 bbl. Although the total for 1949 was slightly less than for 1948, a new all-time high for the country of 1,476,000 B/D was reached in November, 1949, and at year's end, production was averaging 1,460,000 B/D.

Production from Western Venezuela, where the Bolivar Coastal Field and the La Paz and Mara Cretaceous Fields are located, amounted to 69 per cent of the entire country. Industry cumulative production passed the five billion barrel mark a few days prior to the end of the year and on December 31 had reached a total of 5,003,932,000 bbl.

A total of 682 wells were completed during 1949 compared with 886 in 1948. 1949 completions included 446 field wells, of which 430 were successful, and 236 exploratory wells, of which 168 were oil producers and four were gas wells. An average of 100 rigs were operated throughout 1949 compared with 129 during 1948. Rigs operated in 1949 decreased from 131 at the beginning of the year to 80 at the close of the period.

Wildcat drilling resulted in the discovery of 16 new fields, seven of which are in the Greater Oficina area of central Anzoategui, one in the Santa Ana-San Joaquin-El Roble area of northern Anzoategui, three in the Las Mercedes-Tucupido area of eastern Guarico, three in Western Venezuela and two in the State of Barinas. Ten successful deeper pool tests were also completed. Discoveries of and extensions to proved reserves exceeded production during the year.

Of particular interest concerning exploration drilling was the unusual number of deep wildcats drilled in Venezuela during the year. Shell's CI-1 on the southwestern shore of Lake Maracaibo was abandoned at a depth of 15,637 ft and currently is the deepest well in the Western Hemisphere outside of the U. S. A. Shell's successful wildcat, Sibucara-5, near the city of Maracaibo, completed at a depth of 13,451 ft, is one of the world's deepest commercial oil wells. A total of ten wells were completed or abandoned at depths greater than 12,000 ft and three wells were drilling below that depth at year's end.

Exports of crude and products from Venezuela totaled 462,208,000 bbl, including bunkers, compared with 472,734,000 bbl in 1948.

Refinery capacity of the country was increased from 130,000 B/D to approximately 240,000 B/D by the completion of Shell's 60,000 B/D plant at Cardon and Creole's 60,000 B/D refinery at Amuay, both on the west coast of the Paraguana Peninsula. Creole's small 10,000 B/D topping plant at La Salina on Lake Maracaibo was dismantled when the Amuay plant went on stream. The Venezuelan Gulf Refining Company and the Texas Petroleum Company continued with the erection of their joint 25,000-35,000 B/D refinery at Puerto la Cruz, and it is expected that the plant will be completed before the middle of 1950. Other construction during the year included an 18-inch pipe line from Richmond's Boscan Field to a terminal at Bajo Grande south of Maracaibo, a crude stabilization, absorption, desalting, dehydration and pressure maintenance plant in the Mulata Field and a natural gasoline recovery plant in the La Paz Field.

Water flooding was tried for the first time in Venezuela by the Mene Grande Oil Company in its Ambrosio Field in Lake Maracaibo and its Oficina Field in central Anzoategui.

No new concessions were granted in 1949, and as the result of renouncements during the year, the total area of concessions in force was reduced from 18,602,000 acres at the beginning of the year to 17,147,000 acres at year's end.

Exploration activity in the field decreased during the year as may be seen from the following tabulation:

	TOTAL INDUSTRY PARTY MONTHS	
TYPE	1949	1948
Seismic	232.0	309.8
Gravity	94.2	104.1
Magnetic	1.2	1.5
Surface	259.4	221.5
Structure Drill	34.5	54.0
Total	621.3	690.9

Following is a comparison of the number of field parties active in Venezuela at the beginning and the end of the year:

	DEC. 31	DEC. 31
TYPE	1949	1948
Seismic	15.0	20.8
Gravity	3.0	8.6
Magnetic	-	-
Surface	24.0	20.0
Structure Drill	2.0	4.0
Total	44.0	53.4

* CREOLE PETROLEUM CORPORATION, CARACAS, VENEZUELA.
MANUSCRIPT RECEIVED IN THE OFFICE OF THE INSTITUTE, MAY, 1950.

TABLE 2 - SUMMARY OF DRILLING OPERATIONS IN VENEZUELA DURING 1949

IMPORTANT WILDCATS DRILLED IN 1949

LINE NUMBER	STATE AND NAME OF WELL	COORDINATES-METERS ORIGIN	NORTH	EAST	T.D. FT.	SURFACE FORMATION	DEEPEST HORIZON TESTED	DRILLED BY	INITIAL PRODUCTION PER DAY OIL U.S. BBL.	GAS MILLIONS	CONDENSATE U.S. BBL.	CHOKE FRACTIONS OF AN INCH	PRESSURE, LBS. PER SQ. IN. CASING	TUBING	REMARKS
	ANZOATEGUI	Barce-													
1	Soto-1	Lona	197,235	544,825	12,084	Pleisto-	Oligocene	Mene Grande Oil	-	x	Gas Well	3/8-	-	800/900	New Field Wildcat
2	SM-1	"	195,135	529,168	10,741	cene	"	" "	1,135	x	x	1/4 5/16	475	900	Discovery
3	OZ-4	"	172,614	546,691	6550	"	"	" "	648	x	x	1/4 1/4	650	350	New Pool Wildcat
4	NS-207	"	180,301	715,927	9645	"	"	" "	373	x		1/4	-	700	New Pool Wildcat
5	NG-6	"	149,195	540,253	5310	"	"	" "	222	x	x	3/8	-	220	New Pool Wildcat
6	MM-1	"	154,528	596,419	6112	"	"	" "	Abandoned-Non Commercial (low gravity oil) " "						
7	BI-6	"	194,461	481,900	11788	L.Miocene	Cretaceous		Abd. Non Commercial (Gas & Condensate) Deeper Pool Test						
8	Moriche-1	"	175,095	537,776	7800	Quat.	Oficina	Socony Vac. Oil	1,369	x	x	5/16	650	850	Dual Zone Disc.
9	JLV-1	"	175,235	586,033	8703	Pleisto- cene	Oligocene	Socony-Mereg	148	x	x	1/4	-	380	New Pool Wildcat
10	JLV-2	"	175,679	584,493	8370	Quat.	Oficina	Socony-Mereg							Not commercial
11	Cachicamo-1	"	147,489	512,400	5006	Pleist.	Cretaceous	Ven. Atlant. Ref.	32	x	x	Open Flow			15° Oil Disc. Suspended
12	Unare-1	"	197,430	442,630	8612	Miocene	Oligocene	Ven. Atlant. Ref.							
13	FX-1	"	191,189	545,775	11001	Mesa	Oligocene	Creole Pet. Corp.	605	x	x	1/4	1040	1150	Discovery
14	JA-1	"	204,301	496,097	9461	x	x	Phillips Oil Co.	x	x	x	x	x	x	Discovery
15	VG-1	Clar-	86,139	80,641	14036	Miocene	x	Shell							Dry
16	Wi-1	ines	104,244	76,130	13100	Recent	x	Shell							Dry
16-A	Pradera-1	Barce-	173,940	535,510	7565	Quat.	Oficina	Socony Vac. Oil	75	x	x	5/16	-	F/H	Discovery
17	APURE Apure-3	Lona "	51,585	413,818	6423	x	x	Mene Grande Oil							Dry
18	BARINAS Salvan-1	Bar-	111,997	95,569	11008	Quat.	x	Socony							Operations susp.
19	Salvestre-4	inas "	105,491	92,078	9901	Quat.	x	Socony							Operations susp.
20	Salvestre-5	"	101,435	89,238	9460	Quat	x	Socony							Operations susp.
21	DELTA AMACURO PSA-1	Natu-	221,511	303,843	12150	Plio-Plei	Miocene	Creole Pet. Corp.	Dry - Completed as shallow water well						
22	PSA-2	ran. "	223,961	302,773	6984	Plio-Plei.	Miocene	Creole Pet. Corp.							Dry
	FALCON	Piritu													
23	Esperanza-1	s-o	S.34,296	51,762	4773	Eocene	Eocene	Creole Pet. Corp.							Dry
24	Abundancia-1	"	S.46,092	43,291	3515	Miocene	Miocene	Creole Pet. Corp.	Possible Pinpr. 75 BPD						
25	Cosme-1	"	S.52,703	31,794	6954	Miocene	Mio-Olig	Creole Pet. Corp.							Dry
26	LR-1	Lobe-	198,350	219,999	7734	Miocene	Eocene	Creole Pet. Corp.							Dry
	GUARICO	Juro													
27	GX-1	Valle de la Pascua	191,922	122,682	4195	Tertiary	La Pascua	S.A.P. Las Merc.							Dry
28	GX-2	"	191,922	123,732	4177	Tertiary	La Pascua	S.A.P. Las Merc.							Dry
29	Mercedes-152	"	203,461	175,902	3400	Tertiary	Holdecito	S.A.P. Las Merc.							Dry
30	Mercedes-155	"	202,936	175,061	4972	Tertiary	La Pascua	S.A.P. Las Merc.							Dry
31	Mercedes-156	"	207,456	178,308	5459	Tertiary	Cretaceous	S.A.P. Las Merc.							Dry
32	Mercedes-161	"	193,449	142,745	4400	Tertiary	Cretaceous	S.A.P. Las Merc.							Dry
33	La Pascua-3	"	207,556	181,598	2725	Tertiary	Chaguaramos	S.A.P. Las Merc.	190	x	3/16			410	Discovery
34	Piraguas-1	"	186,086	131,830	3670	Tertiary	La Pascua	S.A.P. Las Merc.							Dry
35	Valle-2	"	222,889	160,812	6185	Tertiary	La Pascua	S.A.P. Las Merc.							Dry
36	Barso 6-1	Barce- lona	149,464	450,582	4966	x	x	Ven. Atlant. Ref.							
37	Ruiz 3-1	"	180,784	398,050	4535	Eocene	Oligocene	Ven. Atlant. Ref.	228	x		1/4	275		Dual compl.
									283	x		1/4		320	Discovery
38	Saban 2-15	"	186,800	370,900	7695	Miocene	Cretaceous	Ven. Atlant. Ref.		4.7		3/4		225	Gas Well
39	Tucupido-41	"	209,727	378,646	5436	Miocene	Oligocene	Ven. Atlant. Ref.							Dry
40	TBX-1	"	215,000	374,740	4630	Miocene	Oligocene	Ven. Atlant. Ref.							Dry
41	Guavinita-8	Valle de la Pascua	184,460	135,966	4782	Chaguar- amos	Cretaceous	S.A.P. Las Merc.	130	x		3/16		215	Deeper Pool Test
42	Mercedes-159	"	193,999	152,718	5128	Chaguar- amos	Cretaceous	S.A.P. Las Merc.	236	x		15/64		450	Deeper Pool Test
43	Mercedes-167	"	197,461	159,275	4490	"	La Pascua	S.A.P. Las Merc.	191	x		3/16		415	Deeper Pool Test
44	Palacio-55	"	179,861	145,234	4600	"	Cretaceous	S.A.P. Las Merc.	30	x		1/2			Deeper Pool Test
	MONAGAS														
45	Sota 1-2	Naturin	146,901	270,293	10433	Recent	Cretaceous	Texas Pet. Co.							Dry
46	JGE-28	"	214,088	173,652	11997	Plio-Plei.	Cretaceous	Creole Pet. Corp.	Old hole deepened						Dry
47	JGE-30	"	215,838	171,321	8365	" "	Cretaceous	Creole Pet. Corp.	" "						Dry
48	JD-5	"	205,410	168,631	12598	" "	Oligocene	Creole Pet. Corp.							Dry
	ZULIA														
49	Santa Cruz-1	Mcbo.-	16,972	7,692	14045	Eocene	Cretaceous	Creole Pet. Corp.							Dry
50	TAR-1	Cath.	26,835	W12,103	8032	Eocene	Eocene	Creole Pet. Corp.	Abd. - Mechanical difficulties						
51	Barua-1	"	S189,743	73,890	12484	U. Tert.	Eocene	Creole-Mereg-Richmd.							Dry
52	CI-1	"	S145,337	W95,941	15637	Recent	x	Shell	Deepest well in Venezuela						
53	ZL-1	"	S 9,038	30,163	14436	Eocene	x	Shell							Suspended
54	Sabucare-5	"	2,801	W 8,483	13451	Younger Tert.	Cretaceous	Shell	907.2	x		2-2" Cag 1-1" tbg	1225	250	Discovery
55	LB-511	"	S 70,033	61,073	2746	"	Miocene	Shell							Dry
56	LB-512	"	S 74,395	64,744	3600	"	Miocene	Shell							Dry
57	LB-513	"	S 73,001	63,273	4338	"	Miocene	Shell	54	x		1/8	x	x	Discovery
58	LB-514	"	S 71,419	65,423	2720	"	Miocene	Shell							Dry
59	Zulia LJ-1	Mcbo. Cruz de Morillo	179,049	194,173	9328	Quat.	Eocene	Richmond Expl. Co.							Dry (Abd.)
60	Zulia 7A-1	"	185,181	164,502	8705	Quat.	Eocene	Richmond Expl. Co.	450			Pumping			Discovery (Est.)
61	Zulia 7L-12	"	180,928	164,700	9451	Quat.	Eocene	Richmond Expl. Co.							Dry (Abd.)
62	Zulia 26L-2	"	149,603	106,512	11940	Miocene	Cretaceous	Richmond Expl. Co.							Non-commercial
63	Peten-148	Mcbo.-	S51,343	32,121	6484	Pleist.	Eocene	Mene Grande Oil	134	x	x	1/4	x	50-120	Deeper Pool Test
64	Poco-1	Cath.	S161,445	72,940	10529	Miocene	Olig-Miocene	Mene Grande Oil							Dry
65	6-12L-1	"	30,008	W22,234	10406	U. Mio.	Cretaceous	Mene Grande Oil	6140	x	x	5/8 & 1/2	1100	1100	New Pool Wildcat

TABLE I - OIL AND GAS PRODUCTION STATISTICS FOR VENEZUELA DURING 1949

LINE NUMBER	FIELD (County)[a]	PRODUCING FORMATION NAME AND AGE[b]	YEAR OF DISCOVERY	OIL PRODUCTION			GAS PRODUCTION			GAS/OIL RATIO[d] MCF/BBL	CONDENSATE PRODUCTION Thousands of Bbl	
				AREA PROVED ACRES	BARRELS TO END OF 1949	BARRELS DURING 1949	AREA PROVED ACRES	MILLION CU FT TO END OF 1949	MILLION CU FT DURING 1949		TO END OF 1949	DURING 1949
	EASTERN VENEZUELA											
1	Anzo	Oficina, Mio-Olig	1934	647	40,239	11,134	x	x	7	.629	0	0
2	Casco Seco	Oficina, Mio-Olig	1946	338	662,778	324,230	x	x	522	1.610	0	0
3	Chaure	Oficina, Mio-Olig	1947	5,402	6,635,962	6,413,035	x	6,538	6,315	.984	0	0
4	El Roble	Merecure, Olig Oficina, Mio-Olig	1939	14,674	17,194,498	1,889,699	x	101,302	16,276	8.611	0	0
5	El Tom	Merecure, Olig Oficina, Mio-Olig	1947	1,788	1,130,039	756,215	x	1,389	889	1.176	0	0
6	Fria *	Oficina, Mio-Olig	1947	714	693,725	345,132	x	1,180	834	2.416	0	0
7	Guara *	Oficina, Mio-Olig	1942	8,649	134,057,482	24,662,136	x	x	26,855	1.089	0	0
8	Guavinita	La Pascua, Mio-Olig	1948	425	188,559	176,802	x	226	220	1.243	0	0
9	Guico	Oficina, Mio-Olig	1944	1,610	25,170,120	4,486,430	x	25,453	5,439	1.208	0	0
10	Inca	Oficina, Mio-Olig	1949	900	34,548	34,548	x	54	54	1.563	0	0
11	Jusepin	La Pica, Mio Carapita, Olig	1938	17,012	119,105,191	11,526,406	x	227,890	39,232	3.412	0	0
12	LaCeiba	Merecure, Olig	1946	400	230,269	56,274	x	x	54	.995	0	0
13	Leona *	Oficina, Mio-Olig	1938	5,913	10,693,293	2,044,612	x	x	2,194	1.073	0	0
14	Mata Grande	La Pica, Mio	1946	500	1,471,092	662,006	x	x	x	x	0	0
15	Mercedes	La Pascua, Mio-Olig Cretaceous	1941	3,000	5,764,084	3,660,158	x	x	x	x	0	0
16	Merey *	Oficina, Mio-Olig	1934	1,198	263,462	104,041	x	x	81	.779	0	0
17	Mulata	La Pica, Mio	1941	8,486	51,921,224	6,760,741	x	104,370	20,952	3.099	0	0
18	Nipa *	Oficina, Mio-Olig	1945	7,347	25,644,416	12,650,015	x	x	17,389	1.374	0	0
19	Oficina *	Oficina, Mio-Olig	1937	17,877	153,360,490	14,826,660	x	x	20,946	1.413	0	0
20	Palacio	Peñalcito, Mio-Olig	1946	830	2,436,249	1,849,951	x	1,451	1,065	.586	0	0
21	Pedernales	La Pica, Mio	1933	1,204	12,544,683	2,110,965	x	7,822	972	.413	0	0
22	Pelayo	Oficina, Mio-Olig	1947	298	189,473	114,982	x	x	x	x	0	0
23	Pirapa	La Pascua, Mio-Olig	1949	50	180	180	x	x	x	.346	0	0
24	Pirital (Aripa)	La Pica, Mio	1945	40	87,372	8,237	x	x	x	x	0	0
25	Quiamare	Oficina, Mio-Olig	1942	3,349	695,933	49,376	x	x	78	1.580	0	0
26	Quiriquire	Quiriquire, Plio Merecure, Olig	1928	11,885	326,416,081	23,267,580	x	151,723	14,846	.638	0	0
27	Ruiz	La Pascua, Mio-Olig	1949	2,065	181,774	181,774	x	x	x	x	0	0
28	Salem	Chaguaramos, Olig La Pascua, Olig	1947	330	126,198	100,337	x	x	x	x	0	0
29	San Joaquin	Oficina, Mio-Olig Merecure, Olig	1939	12,465	40,827,774	6,073,728	x	119,096	22,304	3.704	0	0
30	San Roque	Oficina, Mio-Olig Merecure, Olig	1949	720	1,109,141	1,109,141	x	x	x	x	0	0
31	Santa Ana	Merecure, Olig	1936	2,085	6,333,081	1,575,896	x	x	4,690	2.969	0	0
32	Santa Barbara	La Pica, Mio	1941	3,542	54,741,755	5,544,373	x	x	x	x	0	0
33	Santa Rosa	Oficina, Mio-Olig	1941	2,742	5,820,752	1,108,183	x	x	3,413	3.080	0	0
34	Temblador	Oficina, Mio-Olig	1936	4,328	31,940,760	3,721,256	x	9,119	1,252	.336	0	0
35	Travieso	La Pica, Mio	1941	2,900	18,562,368	2,517,558	x	x	4,436	1.728	0	0
36	Tucupido - Tamon	Peñalcito, Olig Chaguaramos, Olig	1946	2,975	4,892,241	3,862,063	x	x	x	x	0	0
37	Tucupita	Oficina, Mio-Olig	1945	1,295	6,255,426	2,130,537	x	1,131	466	.216	0	0
38	Yopales *	Oficina, Mio-Olig	1937	1,735	2,786,805	1,255,671	x	x	1,493	1.189	0	0
39	Others (1)			8,193	2,231,340	14,677	x	x	x	x	0	0
40	Total - Eastern Venezuela			159,601	1,072,440,697	148,004,538	x	x	x	x	0	0
	WESTERN VENEZUELA											
41	Ambrosio	Mostrenco, Eoc	1928	40	74,754	36,205	x	x	x	x	0	0
42	Bolivar Coastal Field	Mio, Olig, Eoc	1917	187,901	3,155,219,175	299,157,156	x	x	164,370	.717	0	0
43	Boscan	Icotea, Olig Las Flores, Eoc	1946	3,350	1,554,822	1,283,022	x	231	194	.151	0	0
44	Casaretto	Cuiarao, Mosquito, Mio	1931	551	41,105,195	1,426,110	x	25,468	1,531	1.073	0	0
45	El Mene de Mauroa	Mio	1921	901	23,555,737	133,975	x	x	x	x	0	0
46	Hombre Pintado	Mio	1927	129	4,500,816	254,203	x	x	x	x	0	0
47	La Concepcion	Concepcion, Eoc Colon, Lagunu, Cogollo	1925	2,039	33,825,899	812,043	x	56,613	1,116	1.374	0	0
		Cretaceous	1948			577,416	x	724	544	.942	0	0
48	La Paz	Concepcion, Eoc Guasare, Paleo	1925	20,251	154,934,078	1,170,531	x	30,113	625	.534	0	0
		Colon, La Luna Cogollo, Cre	1944			48,166,930	x	90,207	32,962	.684	0	0
49	Los Manueles	Sdy shales, Mirador, Eoc	1927	833	41,009,660	801,332	x	30,903	918	1.146	0	0
50	Mara	Cre L	1945	20,992	56,678,005	27,088,187	x	x	17,572	.648	0	0
51	Mene Grande	Mio Pauji, Misoa, Trujillo Eoc	1914	8,950	339,512,076	17,230,776	x	204,915	6,357	.369	0	0
52	Motatan	Mio-Olig, Eoc	1939	32	722,302	78,402	x	x	49	.620	0	0
53	Subacara	Cre L	1948	4,469	2,453,192	2,358,643	x	4,008	3,850	1.632	0	0
54	Tarra (Las Cruces)	Mirador, 3rd Coal, Eoc	1916	2,161	70,651,057	2,487,309	x	36,519	1,342	.540	0	0
55	West Tarra	Cre L	1947	3,879	1,988,545	1,174,173	x	6,110	3,673	3.128	0	0
56	Others (2)			2,625	3,748,379	41,557	x	x	x	x	x	x
57	Total - Western Venezuela			259,103	3,931,533,692	334,268,170	x	x	x	x	0	0
58	Total - All Venezuela			418,704	5,003,974,389	482,272,708	x	x	x	x	0	0

* Originally one field, now a district containing two or more fields.

(1) "Others" include the following fields: Casanoco, Capacho, Arapus, Fretes, Las Ollas, Los Caritos, Maguri, Moriche, Orocual, Pelao, Pelon, Socororo, Cachicamo, Urama (Tabasca)

(2) "Others" include the following fields: El Mene de Acosta, El Menito, Totuno, Ensenada, Las Palmas, Los Barrosos, Macoa, Maron, Mecha, Misoa, Monte Claro, Rio de Oro, San Jose.

LINE NUMBER	NUMBER OF WELLS[6]			WELLS PRODUCING DEC. 1949			RESERVOIR PRESSURE LB. PER SQ. INCH		SECONDARY RECOVERY[8]	CHARACTER OF OIL[9]		PRODUCING FORMATION					DEEPEST ZONE TESTED[10] TO END OF 1949	
	COMPLETED TO END 1949	1949		OIL		GAS	INITIAL	AVG. END 1949		GRAVITY A.P.I.	SULPHUR PER CENT	CHARACTER[7]	POROSITY PER CENT[7]	DEPTH TO TOP OF PRODUCING ZONE FT.	PROD. THICKNESS AVG. FT. NET	STRUCTURE[8]	NAME	DEPTH OF HOLE, FT.
		COMPLETED	ABANDONED	FLOWING	ARTIFICIAL LIFT													
1	2	0	0	0	0	0	1,800	x		37	x	S	25	3,000	15	M F	Oficina	5,900
2	3	2	1	3	0	1	1,900	x		39	x	S	25	4,500	30	M F	Oficina	7,576
3	45	44	0	46	0	0	2,500	x		36	x	S	25	5375-7150	60	M F	Oficina	8,701
4	23	4	0	22	0	0	5,050	2,300		32	0.2	S	P	8,300	90	T F	Merecure	11,829
5	8	4	2	4	0	0	x	x		42	x	S	P	6,900	50	A	Merecure	7,930
6	9	1	0	4	3	0	x	x		41	x	S	P	5,700	10	M F	Oficina	6,802
7	263	21	2	183	31	0	2,700	2,300	P	36	1.0	S	P	4,400	175	M F	Cre	8,096
8	9	3	0	8	0	0	x	x		30	x	S	P	3,500	15	M F	Cre	4,792
9	61	2	0	39	0	0	x	x		40	x	S	24	4000-7000	90	M F	Oficina	7,606
10	4	3	0	2	0	0	x	x		38	x	S	25	4,800	30	M F	Oficina	7,000
11	449	0	0	265	24	2	2,700	1,345	P	32	0.7	S	P	3,500	95	A F	Olig	10,367
12	2	0	1	1	0	0	x	x		36	x	S	25	8,000	30	A	Merecure	x
13	36	2	0	30	3	0	3,000	2,400		29	1.3	S	25	6,000	25	M F	Cre	7,443
14	24	0	0	20	0	1	x	x		28	x	S	15-35	4400-4700	15-150	M	Carapita	6,365
15	116	21	0	85	0	0	x	x	P G	31	x	S	P	4,200	25	M F	Cre	6,400
16	9	3	1	0	0	0	1,800	x		17	x	S	25	3,000	15	M F	Oficina	5,900
17	253	10	0	134	40	2	2,580	1,180	P	36	1.0	S	P	4,000	90	S L F	Mio	7,299
18	118	30	0	99	1	0	3,300	x		39	x	S	24	5500-8400	75	M F	Oficina	8,815
19	352	11	2	109	84	2	2,350	1,500	P W	34	0.7	S	25	4,000	75	M F	Cre	7,307
20	42	9	0	36	1	0	1,375	x		30	x	S	P	3,400	30	M F	Cre	4,593
21	29	3	0	8	0	0	3,200	2,318		23	2.8	S	P	5,000	250	A F	Mio	7,853
22	4	1	0	3	0	0	x	x		30	x	S	P	7,500	x	X	Temblador	8,120
23	2	2	0	0	0	0	x	x		39	0.5	S	P	3,475	6	M F	Cre	3,902
24	1	0	0	1	0	0	x	x		33	x	S	P	4,520	x	X	Olig	4,818
25	2	0	0	1	0	0	3,800	3,600		39	x	S	10	x	x	A	Santa Ines	9,000
26	486	49	0	72	125	0	1,160	952		17	1.2	S	20	2,000	180	M	Cre	8,285
27	12	12	0	12	0	0	x	x		32	x	S	P	4,300	x	X	Cre (?)	4,705
28	26	6	2	1	5	1	x	x		40	x	S	P	835-4840	x	X	Cre	5,474
29	84	6	0	61	1	0	3,490	2,019		44	1.0	S	P	3,800	45	A	Merecure	9,519
30	10	10	1	10	0	0	x	x		46	0.1	S	P	x	x	x	Olig	11,401
31	13	2	0	11	0	0	3,075	x		38	0.1	S	19	6,000	300	A S	Merecure	9,631
32	217	3	0	112	56	0	x	x	P	33	x	S	P	3,400	x	M F	La Pica	x
33	16	3	1	9	0	0	3,300	3,300		44	0.1	S	25	5,000	300	A F	Merecure	10,324
34	124	6	0	88	0	1	1,700	1,561		21	1.0	S	24	3,860	45	F	Temblador	4,339
35	125	1	2	67	14	0	x	x		33	x	?	P	3,400	x	M F	La Pica	x
36	55	36	8	39	0	1	x	x		40	x	S	P	3,500	x	X	Cre (?)	6,858
37	67	5	0	37	0	0	x	x		17	x	S	P	5,440	75	M F	Temblador	5,754
38	33	9	1	12	6	1	1,700	1,400		22	1.2	S	22	3,000	30	M F	Cre	6,015
39	63	5	0	1	0	0												
40	3,184	349	24	1,627	394	12												
41	6	1	1	3	0	0	x	x		27	x	S	P	x	x	X	Mostrenco	6,202
42	5,113	204	4	1,032	2,461	1	x	x		12-31	1.3-2.7	S	P	1600-3700	150	M F	Cre	13,841
43	45	23	0	0	0	0	x	x		11	5.2	S	P	6,300	160	N U F	Eoc	9,949
44	133	0	0	20	24	1	900	x	C	48	0.1	S	P	500	35		Miocene	7,720
45	286	0	0	0	26	0	x	x		33	Tr.	S	P	950	50	A	Eoc	5,576
46	54	1	0	1	25	0	x	x		25	x	S	P	1,400	40	A F	Eoc	4,614
47	147	0	0	1	78	0	x	x		37	0.8	S	15	1,500	2,000	A F	Cre	12,085
-	1	0	0	1	0	0	x	x		37	0.9	L	F	10,000	2,000			
48	105	9	3	23	29	0	x	x		22	1.6	S	P	2,000	1,000	A F	Cre	10,055
										34	1.5	I	F	7,000	1,700			
49	39	0	0	11	9	0	x	x		34	0.9	S	20	3,700	1,000	A	Eoc	8,089
50	37	18	0	24	1	0	4,390	3,110		30	1.4	L	F	5,500	1,650	A F	Cre	11,777
51	583	27	0	5	318	0	x	x		18	2.0	S	F	5,000	800	A F	Eoc	6,761
52	-	0	0	0	0	0	x	x		x	x	x	x	x	x	M F	Eoc	x
53	1	0	0	1	0	0	x	x		36	0.8	L	F	12,000	1,200	T	Cre	13,451
54	186	3	0	9	100	0	x	x		31	0.9	S	20	1,000	2,700	A F	Cre	8,795
55	5	3	0	4	0	0	x	x		43	0.3	L-I-S	F	7,000	2,400	A F	Cre	9,642
56	178	2	0	0	0	0												
57	6,926	261	8	1,135	3,071	2												
58	10,130	640	32	2,762	3,465	14												

Index 1949 Production Statistics

DOMESTIC

Alabama, By James Proctor 321
Arkansas, By Donald H. Mackay 131
Atlantic Coastal Plain, By E. W. Berry 166
California, By L. E. Porter and L. W. Chasteen 374
Colorado, By Raymond M. Larsen 344
Florida, By James Proctor 322
Georgia, By James Proctor 322
Hugoton Gas Field, By J. F. Dougherty 373
Illinois, By Alfred H. Bell and Virginia Kline 167
Indiana, By R. E. Esarey and B. E. Brooks 1
Kansas, By J. B. Steele, Jr., and J. H. Page 95
Kentucky, By Coleman D. Hunter, Iley Browning, Jr., Walter Scott Browning and Woodson Diamond 83
Louisiana, By Leo W. Hough and Arnold C. Chauviere 31
Michigan, By G. E. Eddy 329
Mississippi, By James Proctor and H. N. Morse 323
Missouri, By Frank C. Greene 92
Montana, By Raymond M. Larsen 345
Nebraska, By E. C. Reed 93
New Mexico, By John M. Kelly and Edward E. Kinney 314
New York, By William Lynn Kreidler 29
North Dakota, By Raymond M. Larsen 345
Ohio, By R. L. Alkire 59
Oklahoma
Central, By Charles S. Larkey 220
East Central, By Thomas Baird 244
East Central Creek County, By M. B. Penn 252
Northern, By George R. Elliott 227
Oklahoma City Area, By Ward M. Edinger 264
Osage County, By R. E. McMillen 256
Seminole Area, By James A. Bermingham, Jr. 233
Southeast and Southwest, By Dwight L. Becker 209
Pennsylvania, By Charles R. Fettke 280
Rocky Mountain Region, By Raymond M. Larsen 343
South Dakota, By Raymond M. Larsen 345
Tennessee, By R. C. Milhous 290
Texas
East and East Central, By John S. Bell and Billy W. Evans 118
North, By W. G. Sinclair 151
North Central, By J. B. Harrell, Jr. 65
Panhandle, By J. F. Dougherty 368
South, By C. S. Wilson 266
South Central, By William H. Spice, Jr. 76
Upper Gulf Coast, By Paul B. Leavenworth and Sidney A. Parkans, Jr. . 14
West, By L. H. Thawley 293
Utah, By Raymond M. Larsen 346
Washington, By L. E. Porter and L. W. Chasteen 375
West Virginia 398
Wyoming, By Raymond M. Larsen 346

FOREIGN

Bahrein Island, Saudi Arabia and Qatar, By J. T. Duce and N. E. Baker . . 400
Brazil, By Avelino Oliveira 405
Burma, India and Pakistan 404
Canada, By The Geological Survey of Canada 409
Colombia, By G. F. Dean and G. Barrow 417
Egypt, By E. le M. Trafford 422
Far East 427
Including Indonesia, North Sumatra, Mid-Sumatra, South Sumatra, British Borneo, Northeast Borneo, Southeast Borneo, Java, Netherlands New Guinea, China, Philippines, Papua and Mandated Territory, Australia, Formosa, Japan and Assam.
Germany, By A. Bentz 433
Iran, By Anglo-Iranian Oil Co., Ltd. 437
Iraq 416
Kuwait, By Kuwait Oil Co., Ltd. 441
Netherlands, By A. A. G. Schieferdecker 408
Peru 444
Trinidad, By P. E. T. O'Connor 449
Venezuela, By D. C. Porterfield 453

The Drift of Things

. . . as followed by **EDWARD H. ROBIE**
Secretary AIME

Utilization of Engineers

In the last World War the special talents of engineers, like those of many other groups of professional men, were to a large extent wasted. Further, their training in the colleges was interrupted, so that the postwar supply was inadequate. Only in the last year has the supply equaled the demand. Members of the national engineering societies have often suggested that some action should be taken looking to a better utilization of their talents in future emergencies. They are not trying to evade service to their country, although few people look forward to taking up a gun and going out to shoot somebody, but they feel that it is to the country's interest as well as their own to serve where they can to the best advantage.

With the draft boards again picking up engineers for nonengineering military service, the problem has again become acute. Engineers Joint Council, representing the AIME, ASME, AIEE, ASCE, and AIChE, has therefore set up an Engineering Manpower Commission, in which the American Society for Engineering Education is also represented. Its function is to develop "policies and procedures designed to secure the most effective use of engineering skills and experience in industry and government (civilian and military) during the emergency and to take necessary steps within the scope of EJC to put such policies and procedures into practice." Three AIME representatives, one for each Branch of Institute activities, are acting on this Commission: George B. Corless, of the Standard Oil Co. (N.J.); M. W. Lightner, Carnegie-Illinois Steel Corp.; and H. J. O'Carroll, Kennecott Copper Corp.

The Commission held an organizational meeting in New York on October 12, and two or three subsequent meetings have also been held or planned. Similar groups have been working through the American Chemical Society, the American Institute of Physics, and the National Research Council, and study of the general problem of the best utilization of professional men has also been undertaken by six committees advisory to General Hershey, director of Selective Service. These groups are reporting to the National Security Resources Board.

One is likely to underestimate the complexities of the problem, and perhaps to overlook the political angles. Almost every skilled laborer thinks he can serve his country better than by carrying a gun, and why should any white collar man be deferred. Military service by practically every physically fit man was fundamental in the idea of the Selective Service Act. Even if the idea be accepted that outstanding engineers and scientists be treated differently from others, the problem remains of registering them, finding the proper thing for them to do, and deciding on a cutoff point.

The Commission has made no final report, as this is written, but has agreed that fundamentally the long-range problem is twofold: (1) maintaining an adequate supply of personnel of the necessary abilities, and (2) assigning this personnel to the maximum advantage. The programs to be recommended must also take account of what is desirable on a large-scale or full mobilization basis, on a partial mobilization basis, with medium military forces, and, lastly, on the present 3,000,000-man military force basis.

To maintain an adequate supply of engineers it is felt that deferment from military service should be granted to those wishing to enter engineering schools who show exceptional promise, and that definite percentages of this group be advanced each year to the sophomore, junior, and senior classes. Eighty, 85, and 90 per cent, respectively, has been suggested, so that 61 per cent of a well-selected freshman group would graduate. Fixed survival percentages would prevent any complaint of academic grade juggling.

For all-out mobilization, registration of all scientific and technical personnel, both men and women, between the ages of 18 and 65 has been proposed. Registrants would include those with bachelor or higher degrees in engineering, physics, and chemistry; those enrolled in training programs; those employed in these fields without regard to education; and perhaps highly skilled technicians. Selective Service would handle the registration. The group thus registered, after proper screening, would constitute a "National Technical Reserve," membership in which would be comparable to membership in the armed forces or in the military reserve. Some badge, or other indication of membership, would be desirable because of social pressures.

A "National Technical Manpower Board," with regional and specialized committees, would be set up to assign duties to those registered, including assignment to and withdrawal from the military forces.

For partial mobilization, it is proposed that the above plan be adopted on a skeletonized basis, carrying assignments by the Board only to the extent necessary.

Admittedly, all this should have been done some time ago. But better late than never, and it is hoped that some action may result, either immediately or after any required legislation can be enacted, which will prevent some of the waste of technologic and professional manpower that has until now existed in this country in times of military emergency.

One-Sixth Foreign

AIME members living outside of the United States frequently complain of the difficulty of securing American dollars with which to pay their dues. Efforts have been made to devise some means of easing the burden but so far without result. Deposits of foreign currency to the credit of the Institute cannot be utilized, for the expense of conducting the society has to be paid in American dollars.

As late as 1938, 25 per cent of the membership resided in foreign lands. The exigencies of the last World War reduced this percentage to 16 per cent in 1944, and it has since remained at between 15 and 17 per cent. The current figure is 16 per cent, and of this group of foreign members, 23 per cent are in South America, 21 per cent in Canada, 20 per cent in Europe, and 9 per cent in Mexico. It seems, therefore, that some 2,600 AIME members living in foreign countries can still secure American dollars, so the problem cannot be too acute. Many, of course, maintain balances in banks in this country, particularly American engineers employed abroad.

Personals

EARL B. NOBLE has been appointed petroleum consultant for the National City Bank of New York. He resigned as general manager for Canada of the Union Oil Co. of California to take the position. He is a past president of the American Association of Petroleum Geologists and a fellow of the Geological Society of America. He is also a member of the Instituto Sudamericano del Petroleo, the Pan American Institute of Mining Engineering and Geology and other societies. He has served professionally as division geologist, assistant chief geologist, and chief geologist.

+

EARL G. GAYLORD, vice-president of the California Research Corp., has been awarded a "Certificate of Appreciation" by the Research Committee of the Board of Directors of the American Petroleum Institute. The certificate was presented at the recent API meeting in Los Angeles. Also presented with "Certificates of Appreciation" were C. P. DIMIT, vice-president of the production department of Phillips Petroleum Co.; PAUL D. TORREY, president of Lynes, Inc., and D. L. TRAX, of Gulf Oil Corp.

+

T. E. OCKERSHAUSER, Oklahoma City, is leaving The Globe Oil and Refining Co. after three years as engineer in charge of the Southwest Antioch Gibson Sand Unit. Prior to joining Globe, he was with the Shell Oil Co. for 11 years doing drilling and production work in Kansas, Oklahoma and Illinois. His future plans are indefinite.

+

KEITH E. ANDERSON, area geologist with the U. S. Bureau of Reclamation, was transferred from Salem, Ore., to Kalispell, Mont., for geologic investigations in Kalispell and Walla Walla, Wash., offices.

+

DON O. CHAPELLIS is now connected with the Sunray Corp., Tulsa, Okla.

+

WENDELL R. EDGELL is a geophysics trainee with the Stanolind Oil & Gas Co., Brownfield, Tex., working under the geophysical training program.

R. CHARLES FREDERICK was transferred from the Tulsa office of the Gulf Oil Corp. to the Pittsburgh office.

+

PAUL W. GARRETT, JR., has joined the Peoples Natural Gas Co., Pittsburgh, as a geologist.

+

ROGER GOUTEYRON is now petroleum engineer with the Venezuelan Oil Concessions, Ltd., Maracaibo, Venezuela.

+

A. C. WRIGHT is now working with the Long Beach Oil Development Co., Long Beach, Calif., in the production department as a well-puller.

+

EDWARD L. KARN, JR., is now a trainee with The Texas Co., Thermopolis, Wyo.

+

ROBERT R. LARSON has been made mud and drilling engineer for the Drilling & Exploration Co., Inc., Los Angeles.

+

ALEX S. MURRAY has joined the Imperial Oil, Ltd., Calgary, Alberta, as a drilling engineer in the producing department. He was formerly connected with the Venezuela Atlantic Refining Co., Caracas, Venezuela.

+

HOMER C. OSBORNE, formerly with the Superior Oil Co., has returned to the A&M College of Texas for graduate study.

+

JOHN C. PAPP is now connected with the Transcontinental Gas Pipe Line Corp., Houston. He was formerly associated with J. R. Butler & Co.

+

JOHN H. JENNINGS has been made evaluation engineer for the Deep Rock Oil Corp. He had been petroleum engineer for the Ohio Oil Co.'s Tulsa division for the past five years. In 1939, he joined Sunray Oil Corp. in Tulsa and in 1942 he went with Ohio where he spent a year with the Mountain Fuel Supply Co. at Rock Springs, Wyo., before being transferred to Ohio's Bakersfield, Calif., division. He has also done private consulting work.

PROPOSED FOR MEMBERSHIP

Total AIME membership on September 30, 1950, was 16,737; in addition, 4,184 Student Associates were enrolled.

ADMISSIONS COMMITTEE

E. C. Meagher, Chairman; A. J. Phillips, Vice-Chairman; George B. Carless, John T. Sherman, Lloyd C. Gibson, R. D. Mollison, Plato Malozemoff, Ivan Given, H. P. Croft, F. W. Hanson, T. D. Jones.

Institute members are urged to review this list as soon as the issue is received and immediately to wire the Secretary's office, night message collect, if objection is offered to the admission of any applicant. Details of the objection should follow by air mail. The Institute desires to extend its privileges to every person to whom it can be of service but does not desire to admit persons unless they are qualified.

In the following list C/S means change of status; R, reinstatement; M, member; J, Junior Member; AM, Associate Member; S, Student Associate; F, Junior Foreign Affiliate.

CALIFORNIA

Bakersfield — Nolan, Daniel B. (J).
Compton — Forte, Everett L., (J).
Long Beach — Faulk, Bill L. (J); Vlack, Russell C., Jr. (J).
Los Angeles — Mayer, Edward H. (J).
McKittrick — Dooley, Albert B. (M).
Santa Maria — Evert, Don E. (J).
Van Nuys — Wallace, Thomas H. (M).

COLORADO

Denver — Bryan, William E. (J).

ILLINOIS

Oblong — Latimer, Warren E. (J).

KANSAS

Wichita — Henderson, James C. (J).

LOUISIANA

Bunkie — McGowen, Harold E., Jr. (M).
Lake Charles — Maricelli, James J. (A).
Paradise — Berger, Walter R., Jr. (M).
Rodessa — Moye, John L. (J).
Sulphur — Shrut, Robert H. (J).
Vivian — Perry, Dorsey R. (J).

MISSISSIPPI

Oxford — Dodge, Jay R. (J).

NEVADA

Elko — Cassell, John K. (J).

NEW MEXICO

Roswell — Foley, Edward J. (M).

OKLAHOMA

Bartlesville — Jobin, Thomas J. E. (J).
Ponca City — Boyd, William L. (J).
Tulsa — Brammer, Leo R., Jr. (J); Brett, Floyd O. (M); Evans, Henry M. (M); Finkles, Ernest E. (J); Knoblock, Richard N. (J); Kobdish, Richard M. (M); Moore, Leland E. (J); Orr, Reginald D. (J); Robbins, William L. (J); Tharp, Joshua M. (J).

PENNSYLVANIA

Bradford — Scholl, Erwin S. (J).

TEXAS

Abilene — Garner, John H. (J).
Beaumont — Hogan, Roy E. (J).
Corpus Christi — Underwood, James R., JR. (J).
Dallas — Bush, Robert E. (M); Cable, Edwin D. (J); Dimit, Charles E. (M); Hard, Kenneth E. (J).
Fort Worth — Berger, Walter R. (M).
Houston — Henry, Robert R. (M); Robinson, Cecil D. (J).
Kermit — Everett, Rex M. (J).
Kilgore — LaRoche, William E. (J).
Odessa — Paulsell, William G. (J).
Penwell — Timm, Robert W. (J).
West Columbia — Davis, Douglas R. (J).

ENGINEERING EDUCATION

Continued from Page 7, Section 1

citizens upon any one facet of environment is to ignore the fact that each is only one area of experience which contributes to the whole education. It is, however, one of the objectives of formal education to contribute to this desirable quality by specific or corollary work and by the methods of instruction which are employed.

The capacity to do work and the ability to produce do not necessarily signify physical work or material production. Some form of contribution of the individual to society is the requirement. The capacity to contribute and the type of contribution is a function of the area and the individual considered, but all must possess this capacity. A recognition of the need for this capacity as a basic objective is one means of integrating the formal education with the whole education.

The ability to communicate easily and accurately is likewise necessary to all, but the particular means of communicating will not be the same for all areas or for all individuals. It is the function of the formal educational process to fit the type of communication to the individual's needs.

It is pertinent to inquire how these objectives are to be attained. The prime requisite is to furnish the student with an understanding of environment, not only physical but also social, economic, and political. The analysis which any individual makes of a problem, the proper weighing of the factors pertinent to the problem, and the conclusions and actions derived therefrom are no better than his understanding of the environment within which the problem exists. An understanding of physical environment is basic to an understanding of social, economic, and political environment, because the physical environment controls to a large measure the development of the others.

The engineering program is based upon an understanding of environment. Engineering is in fact a study of the utilization of physical laws within a given environment. It is well to note that this environment has many aspects. Although he must first study physical laws, the engineer must then study the usefulness of such laws in performing desired functions in our society. The choice of methods to be used in performing these functions may be determined by economic, political, and social factors, with all of which the engineer must be familiar.

A second requisite is to provide the student with tools for analysis, for recognition of important factors, and for derivation of logical conclusions. The particular subject matter used in providing these tools is irrelevant except that the tools of analysis may vary somewhat with the subject matter.

The engineering program necessarily includes the elements of analysis. It is not only a part of the engineering student's training to learn these elements, but he must also learn to arrive at definite conclusions based upon his own analysis and must rely upon his own answers. This desirable feature is present in few other programs of education.

A third requisite is to give the student the necessary inspiration to use his tools of analysis within his environment to the best advantage of all. This goal, of course, is reached only through the use of qualified teachers, a condition necessary to any educational program.

In carrying out these requisite features most programs in engineering education make use of devices which have been subject to adverse criticism. The planned program is one of these devices. Critics assume that a planned program is a narrow program which deprives the student of advantages he would have were it not planned. This is not so. The planned program is in fact part of the method of teaching the student his tools of analysis. The program in engineering is designed to give the student all necessary ideas in their proper order, and is no different in accomplishing its purpose from the planned "great book" series of the liberal arts.

The heavy program usually required of engineering students has likewise been criticized. So long as the program is properly planned, the fact that it is heavy is no drawback. In fact, this permits the program to be broader than it could otherwise be. It also aids in giving the student a discipline of work and achievement lacking in other programs.

Applied courses are often severely attacked. The misconception here results from a failure to differentiate between an applied and a descriptive course. The two are not synonomous. The latter has no place in the present-day engineering curriculum, but the former is a fundamental part of the engineering curriculum. It is basic to bringing the student's understanding of his physical environment in focus with the other facets of his environment. It is one of the chief elements in the engineering curriculum which makes it a desirable program.

It is not the intent of this discussion to argue that the engineering educational program is perfect. Rather, it is to point out that the engineering program contains most of the desirable elements sought in up-to-date programs, and to ask the engineer to be more outspoken in a defense of his professional education. It is also hoped that the engineering student will thereby gain inspiration to use the desirable features of his training to greater advantage in affairs outside his profession.

The engineering program needs much improvement, but its basic elements should not be destroyed. ★ ★ ★

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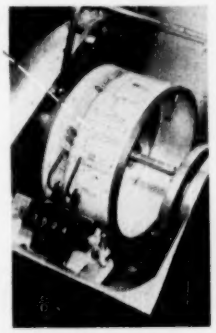

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Nominating Committee And Atlernates Named

As provided in Article IX, Section 2, of the AIME bylaws, the names and addresses of the Nominating Committee for Institute officers for 1952 are given below. In each case, the name in parenthesis is that of the alternate, who is to serve only in the absence of the principal at the meeting of the committee, which will be held at St. Louis during the week of the Annual Meeting, Feb. 19-22, 1951.

Members designated by the Council of Section Delegates: W. L. Zeigler, general manager, Pend Oreille Mines and Metals Co., Metaline Falls, Wash. (Wallace G. Woolf, Box 209, Kellogg, Idaho); Henry T. Mudd, 1206 Pacific Mutual Bldg., Los Angeles 14, Calif. (James A. Kavenaugh, 950 N. Highland Ave., Los Angeles 38, Calif.); Albert Mendelsohn, president and general manager, Cananea Consolidated Copper Co., Cananea, Son., Mexico (P. D. L. Honeyman, vice-president and general manager, Inspiration Consolidated Copper Co., Inspiration, Ariz.); Herbert M. Cooley, assistant metallurgical engineer, Bethlehem Steel Co., Box 2171, Tulsa 2, Okla. (P. P. Manion, Jr., Stanolind Oil and Gas Co., Stanolind Bldg., Tulsa, Okla.); Paul R. Turnbull, manager drilling and production department, La Gloria Corp., P. O. Box 779, Corpus Christi, Tex. (M. D. Cooper, National Coal Association, 5430 Aylesboro Ave., Pittsburgh 17, Pa.); Philip D. Wilson, Lehman Bros., 1 William St., New York, N. Y. (James Douglas, Phelps Dodge Corp., 40 Wall St., New York 5, N. Y.); R. Schuhmann, Jr., associate professor of process metallurgy, MIT, 77 Massachusetts Ave., Cambridge 39, Mass. (H. Rush Spedden, MIT, Cambridge 39, Mass.); Herbert R. Hanley, emeritus professor of metallurgy, Box 318, Rolla, Mo. (L. P. Davidson, Box 222, Monsanto, Ill.); Richard F. Miller, assistant to vice-president, research and technology, Carnegie-Illinois Steel Corp., 434 Fifth Ave., Pittsburgh 30, Pa. (John T. Ryan, Jr., Mine Safety Appliances Co., 201 N. Braddock Ave., Pittsburgh 8, Pa.); Harry M. St. John, superintendent, Department 5, Crane Co., 4100 S. Kedzie Ave., Chicago 5, Ill. (Rudolph Tietig, Jr., engineer, A. J. Boynton & Co., 58 E. Washington St., Chicago 2, Ill.); E. D. Dickerman, 2251 S. Cook St., Denver 10, Colo. (C. L. Barker, 308 Jasmine St., Denver, Colo.)

Members designated by the Branch Councils: S. J. Swainson, director mineral dressing laboratory, American Cyanamid Co., 1937 W. Main St., Stamford, Conn. (Veleair C. Smith, Kanawha Valley Bldg., Charleston, W. Va.); J. Murray Riddell, head, department of mining engineering, Michigan College of Mining and Technology, Box 144, Houghton, Mich. (Richard W. Smith, 1615 H St. N.W., Washington 6, D. C.); Harold K. Work, director, research division, College of Engineering, New York University, University Heights, New York 53, N. Y.; Lloyd E. Elkins, production research director, Stanolind Oil and Gas Co., P.O. Box 591, Tulsa 2, Okla. (R. C. Earlougher, 319 E. 4th St., Tulsa 3, Okla.)

The committee will welcome suggestions for the official slate for 1952. The following offices are to be filled: president for 1952, president-elect (president for 1953), two vice-presidents, and five other directors. The terms of the following directors expire in February, 1952; all are eligible for re-election: L. E. Young, A. B. Kinzel, Philip Kraft, H. W. Johnson, William J. Coulter, Erle V. Daveler, James L. Head, and George P. Swift. ★ ★ ★

Program For Annual Meeting Takes Form

The annual meeting of the American Institute of Mining and Metallurgical Engineers will be held at the Jefferson and Statler hotels in St. Louis, Mo., Feb. 19 to 22, with the former hotel as official headquarters. The welcoming luncheon, smoker and student forum on Monday night, the informal dance, Tuesday night, and the annual banquet and president's reception, Wednesday night, will be at the Jefferson Hotel. The Metals Branch and Petroleum Branch dinners on Tuesday night will be at the Statler Hotel. The Mining Branch, except for three sessions at the Statler Hotel, will present its technical program at the Jefferson and the Metals and Petroleum branches will hold their sessions at the Statler.

The Council of Section Delegates will meet on Saturday and the Board of Directors will convene in general session on Sunday afternoon, at the Jefferson. The annual business meeting of the Institute will be on Tuesday afternoon. The Mineral Industry Education Division will hold its usual Sunday afternoon and evening sessions.

Whereas the technical program for Monday through Thursday still is in a state of flux and the meeting schedules shown here are tentative, there is a degree of fixation in that it has been necessary to assign rooms of appropriate seating capacities to sessions of anticipated attendances.

The Petroleum Branch will hold three technical sessions, for which 10 to 12 papers variously on drilling, logging, production practices, phase relations and field performance are in prospect, plus the usual production review and an open meeting of the Branch Executive Committee. The technical and reviews sessions will probably be scheduled for Monday and Tuesday.

The annual dinner of the Petroleum Branch will be on Tuesday evening. ★

AIME Finances Reviewed By Board of Directors

Reviews of the financial position of the AIME in the current year, as made at recent meetings of the Directors, indicate that a deficit of some $20,000 may be expected. The budget at the beginning of the year had been precariously balanced at $477,500, but in some instances income has been less than expected and expenses greater. Chief drop from expected income has been in advertising in the three journals, which had been budgeted at $125,000 and now promises to be about $105,000. Expense for the journals may be slightly higher than expected, owing to increased printing and paper costs and to a policy of maintaining their high standard. The directory proved more expensive than anticipated. On the other hand, dues income has been higher than expected, and certain economies in administration and office practices have been attained. Even with the publication of the directory this year, an expense which was not borne in 1949, the deficit promises to be reduced by some $50,000 from 1949 and by more than $60,000 from 1948. ★

Installment Payments For New Members

Many AIME members do not realize, in approaching prospects for membership, that the $20 initiation fee required of Associate Members and Members may be paid in four annual instalments of $5 each. Junior Members do not have to pay any initiation fee; application for such membership may be made at any time before one's 30th birthday anniversary, and Junior Members may retain such status until their 33d birthday anniversary. Then they must become either Associate Members or Members, in either case paying the initiation fee, in $5 annual instalments if desired. ★ ★ ★

TECHNICAL NOTE

Continued from Page 11, Section 1

"H," on the other hand, illustrates a cement to which can be added additional weighting material with increasing depth at which it is used.

Pressure has no effect on the weight of this type of heavy slurry; furthermore, the pumping time of these slurries is not appreciably affected by the addition of the amounts of barytes ore shown in Table I.

The effect of this additive on the porosity and permeability of the set cement was determined by the same procedure as was used for the bentonite. Again, there was little appreciable effect on permeability. The porosity was not as greatly affected by the heavyweight additive as it was by the addition of bentonite. Fig. 5 illustrates the porosity and permeability results of a typical cement. The other brands of cement tested produced similar results and it was concluded that the addition of barytes ore up to 100 per cent of the weight of the cement would not cause excessive porosity and permeability.

There have been no field tests with this additive; however, a number of experimental plug back tests are planned for the future with heavyweight slurries.

Table I — Maximum Slurry Weights

Cement	Depth, ft	Max. Slurry Weight, lb/gal	% Barytes Ore by Vol
Cement "F"	2,000	18.1	100
"	6,000	18.1	100
"	10,000	18.1	100
"	14,000	18.1	100
Cement "G"	2,000	*	*
"	6,000	*	*
"	10,000	*	*
"	14,000	17.4	100
Cement "H"	2,000	*	*
"	6,000	17.3	25
"	10,000	18.5	75
"	14,000	19.0	100

*Cannot be used because of inadequate strength development.

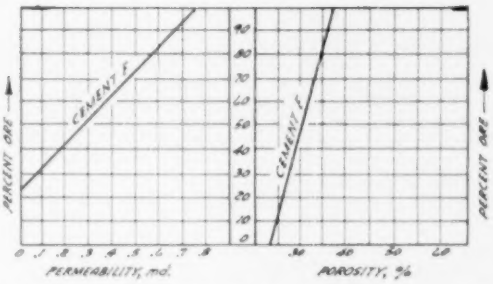

FIG. 5 — EFFECT OF BARYTES ORE ON THE POROSITY AND PERMEABILITY OF SET CEMENT.

SUMMARY

In summation, when slurries heavier than a neat cement slurry are desired, the weight can be increased to as much as 19 lb per gallon by adding up to 100 per cent barytes ore, but pilot strength tests should be conducted with the ore and brand of cement to be used prior to the job in order to insure that the set cement will develop adequate strength. ★ ★ ★

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AIME Publications Available in 1951

Pursuant to Article X of the Bylaws of the AIME, the following information is hereby given as to the "conditions, prices, and terms under which the various classes of members, and Student Associates, severally, shall be privileged to obtain publications of the Institute during the ensuing year."

Publications authorized for 1951 publication include the following:

MINING ENGINEERING, published monthly, containing material, including technical papers, of interest to those engaged in exploration, mining geology and geophysics, and metal, nonmetallic, and coal mining and beneficiation, and fuel technology.

The JOURNAL OF METALS, published monthly, containing material, including technical papers, of interest to those engaged in nonferrous smelting and refining, iron and steel, and physical metallurgy.

The JOURNAL OF PETROLEUM TECHNOLOGY, published monthly in Dallas, containing material, including technical papers, of interest to those engaged in petroleum production, exploration and drilling.

Current copies of any one of the above journals will be supplied to all members in good standing without further charge. (A member ceases to be in good standing if current dues are not paid by April 1.) If more than one of the monthly journals is requested, $4 extra will be charged for an annual subscription, or 75 cents for single copies. Higher prices may be charged for special issues. The nonmember subscription price for each journal is $8 in the Americas; foreign, $9. Student Associates who pay dues of $4.50 will be entitled to the same privileges for all publications as members except as noted below; those who pay $2 will not receive individual subscriptions to the journals but otherwise have the same privileges.

Three volumes of *Transactions* are authorized for 1951 publication as follows: No. 187, Mining Branch; No. 188, Metals Branch; and No. 189, Petroleum Branch. These volumes will be available to members at $3.50 each for a first copy if paid for in advance with dues; otherwise at the nonmember rate of $7 less 30%. Nonmembers, $7 in the United States; foreign, $7.50.

Special volumes now planned for publication in 1951 include the following:

(1) OPEN HEARTH PROCEEDINGS. Price to AIME members, $7; nonmembers, $10.

(2) BLAST FURNACE, COKE OVEN, AND RAW MATERIAL PROCEEDINGS. AIME members, $7; nonmembers, $10.

(3) ELECTRIC FURNACE STEEL PROCEEDINGS. AIME members, $7; nonmembers, $10.

(4) SYMPOSIUM ON TUBE PRODUCTION PRACTICE. Price to be set.

(5) BASIC OPEN HEARTH STEELMAKING, second edition. Price to be set.

(6) STATISTICS OF OIL AND GAS DEVELOPMENT AND PRODUCTION, covering data for year 1949. AIME members, $3; nonmembers, $6.

(7) PETROLEUM CONSERVATION, by Stuart Buckley. Price to be determined.

(8) SYMPOSIUM ON SOLIDIFICATION OF METALS AND ALLOYS. Price to be set.

If dues are paid subsequent to Jan. 31, back issues of Institute publications will be supplied only if adequate stocks are on hand. A member may not receive a volume of *Transactions* or a special volume in lieu of a monthly journal, free of charge on membership. Members in arrears for dues are not entitled to special members' prices for publications.

Rocky Mountain members may have their choice of an annual subscription to one of the monthly journals on request.

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Notice of Dues For 1951 Given

Pursuant to Article II, Section 2, of the bylaws of the AIME, notice is hereby given that dues for the year 1951 are payable Jan. 1 as follows:

Members and Associate Members	$20
Junior Members for the first six years of Junior Membership	12
Junior Members, thereafter	17
Student Associates, including annual subscription to a monthly journal	4.50
Student Associates, without journal subscription	2.00

Mailing of dues bills began in September and will be completed in December. Prompt payment will assure uninterrupted receipt of the journal or journals desired in 1951. If, for any reason, a bill is not received within a reasonable time after the last mailing date, Dec. 31, Institute headquarters should be notified.

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Legion of Honor For 25 Members

Just 25 AIME members qualify next year for the Legion of Honor, having been Institute members for fifty years. They are: H. C. Boynton, Arthur C. Brinker, James F. Brophy, Donald G. Brown, George A. Camphuis, George L. Collord, Thomas Cox, J. V. N. Dorr, Lucien Eaton, John M. Fitzgerald, K. F. Goransson, B. Britton Gottsberger, Herbert R. Hanley, L. F. S. Holland, V. F. Stanley Low, W. T. MacDonald, E. A. Manners, Herbert A. Megraw, F. L. Morris, Horace Moses, Arthur C. Spencer, H. P. Townsend, Charles Henry White, Alexander N. Winchell, Lewis E. Young.

Employment Notices

The JOURNAL will post notices of men and jobs available. Companies and AIME members are invited to use this space, for which there is no charge. Except as noted below, address replies to: Code (appropriate number), JOURNAL OF PETROLEUM TECHNOLOGY, 601 Continental Bldg., Dallas 1. Show return address on envelope. These replies will be forwarded unopened and no fees are involved.

Replies should be addressed to: Engineering Societies Personnel Service, 8 West 40th St., New York 18, N. Y. The ESPS, on whose behalf these notices are published here, collects a fee from applicants actually placed.

POSITIONS

♦ Independent Canadian oil company, with headquarters in Calgary, has opening for senior petroleum engineer particularly experienced in reservoir engineering and production practices. No one with less than seven years' experience in the industry need apply. Give synopsis of education, training and experience. Supply recent photo if possible. Address: 206 Lougheed Building, Calgary, Alberta. All replies will be held in strict confidence.

♦ Position available February 1, 1951, assistant or associate professor with master's degree or higher in petroleum engineering to teach reservoir engineering courses in rapidly growing school with excellent laboratory and other facilities. Qualifications will determine salary, but will be comparable to industry. Location Southwest. Code 527.

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Hydrafrac

Continued from Page 13, Section 1

results obtained in each formation were presented. Formations treated have been located in 36 different counties within the state. Although results obtained in many formations are maintained for a long period of time, some zones result in extremely high initial increase which declines rapidly within three to six months after treatment. The stabilized production after treatment usually is greater than that before and accumulative production over a number of years will undoubtedly result in a very profitable venture. Many wells produce by flowing after treatment, whereas there was nothing but a show of oil before.

Most activity has been found in Oklahoma, North Central Texas and Kansas. Accurate results obtained on wells treated during the first year show that three out of every four wells treated result in a production increase. Although it has been impossible to obtain authentic recent data, a cross-section survey indicates this percentage of success is still maintained.

J. N. McGirl of Tide Water is chairman of the program committee which arranged for the meeting.

The Study Group meetings under the direction of John J. Arps, British American Oil Co., were commenced on October 24 at the University of Tulsa. Jack Tarner of Phillips Petroleum Co. discussed the Shuler-Jones Sand Reservoir in Arkansas which was discovered in September, 1937. A novel approach was used in this discussion by Tarner. He outlined all of the engineering data available on this field prior to unitization in February, 1941, and then explained how these data were used in material balance calculations to predict future performance of the reservoir under both primary and secondary operations. A comparison was then made between these predictions and the actual performance of the reservoir which was subjected to gas injection in July, 1941, and water injection in July, 1944.

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Water Injection

Continued from Page 13, Section 1

In several California projects injectivity indices have been observed to decline as injection progresses. The initial value of the injectivity index does not appear to be related entirely to sand permeability, but to be affected also by viscosity and geological factors. In order to improve the ability of the wells to take water pressure washing, string shooting or string shooting combined with acidization has been included in several instances as part of the well completion program. Breakthrough has been observed to occur in certain California areas of pressures equivalent to only 0.75 psi per foot of depth.

C. R. Dodson, chairman of this lecture series, announced that the next lecture would be held November 27 and that Bob Hawkins of Fullerton Oil Co. would discuss the planning and installation of an actual California water flood, including the selection of mechanical equipment. ★ ★ ★

MicroLogging

Continued from Page 12, Section 1

for useful curves since micro spacings recorded from the customary electrical logging devices would be greatly affected by the bore hole.

The microvolumes measured by the MicroLog permit detailed logging of the formations as well as the detection of mud cake on the face of the permeable zones. Since the mud cake is a greater percentage of the microvolume for the 1½-in. Lateral than for the 2-in. Normal, and since the resistivity of the mud cake is usually less than the resistivity of the formation behind the mud cake, the microcurves are separated. A positive separation occurs in front of those zones which are permeable. Both curves, however, will usually show a value close to the mud cake resistivity.

Loy outlined rules for interpretation and showed examples of MicroLogging in consolidated and unconsolidated formations, including several from California. The California examples illustrated the typical response in sand-shale-shell sections and fractured Miocene silicious shales. The MicroLog should prove to be valuable in sand-shale reservoirs as well as the heretofore difficult analysis of fractured shale zones since it gives an accurate detailed log of permeable zones.

The present technique is the result of considerable research which is now directed toward refinements designed to provide certain of the information now available only through core analysis.

Sixty-six members and guests attended the dinner meeting at the Bakersfield Inn, Bakersfield, Calif., to hear Loy's address and elect officers for next year. New officers are: chairman, D. G. Kingman; program chairman, C. L. Doyle; secretary, M. C. Eastman; treasurer, R. P. Mangold; membership chairman, H. D. Campbell. ★

DID YOU MISS THE AIME FALL MEETINGS?

If so, then you missed getting your

PREPRINTS

A limited number of preprint sets are now available at the Petroleum Branch, AIME, Dallas offices.

These sets include the technical papers presented at the 1950 Petroleum Branch, AIME, Fall Meetings in New Orleans, La., and Los Angeles, Calif.

AIME Members may order these sets of preprints for the prices indicated below. They include:

38 **Technical papers from the meeting held in New Orleans $3.00**

13 **Technical papers from the meeting held in Los Angeles $1.50**

Both sets for $3.50

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Dallas 1, Texas

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* In previous issues

PETROLEUM BRANCH MEETING CALENDAR

DECEMBER Through MAY

DECEMBER

20	Kansas Section
21	South Plains Sub-Section
21	Oklahoma City Section

JANUARY

4	Illinois Basin Chapter
8	Mid-Continent Section
9	Delta Section
10	Mississippi Sub-Section
10	Southwest Texas Section
12	San Antonio-Austin Sub-Section
15	North Texas Section
17	Kansas Section
22	Pacific Petroleum Chapter
25	Oklahoma City Section

FEBRUARY

1	Illinois Basin Chapter
12	Mid-Continent Section
13	Delta Section
14	Southwest Texas Section
15	South Plains Sub-Section
15	Oklahoma City Section
19-22	AIME ANNUAL MEETING, Statler Hotel, St. Louis, Mo.
26	Pacific Petroleum Chapter

MARCH

1	Illinois Basin Chapter
12	Mid-Continent Section
13	Delta Section
14	Southwest Texas Section
15	South Plains Sub-Section
15	Oklahoma City Section
21	Kansas Section
26	Pacific Petroleum Chapter

APRIL

5	Illinois Basin Chapter
9	Mid-Continent Section
10	Delta Section
11	Southwest Texas Section
18	Kansas Section
19	South Plains Sub-Section
19	Oklahoma City Section
23	Pacific Petroleum Chapter

MAY

3	Illinois Basin Chapter
8	Delta Section
9	Southwest Texas Section
14	Mid-Continent Section
16	Kansas Section
17	South Plains Sub-Section
17	Oklahoma City Section
28	Pacific Petroleum Chapter

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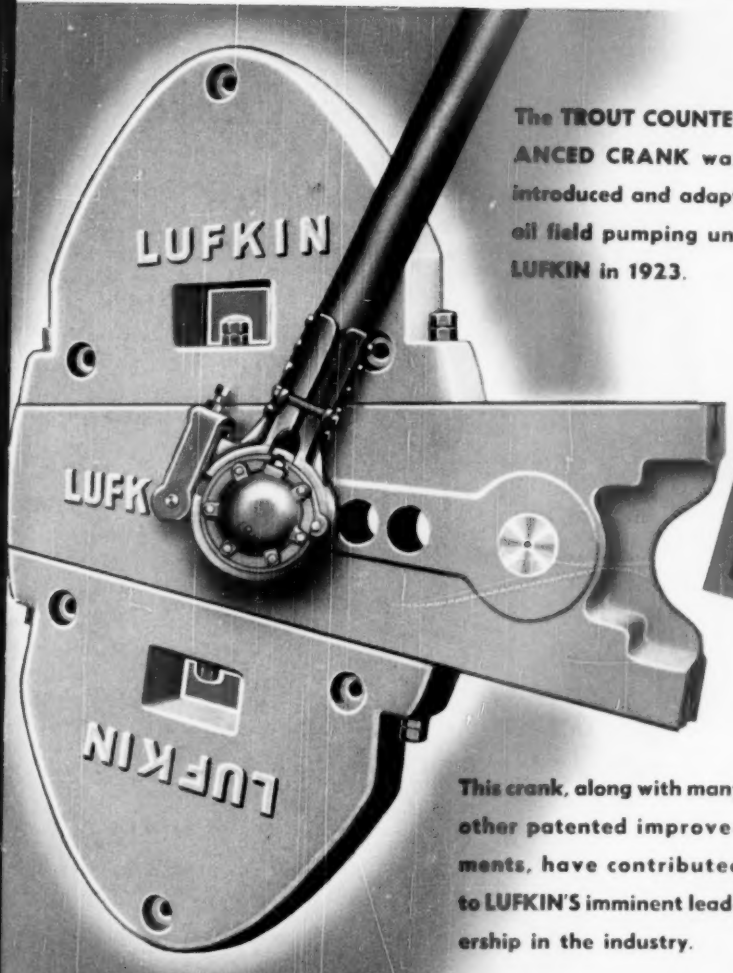

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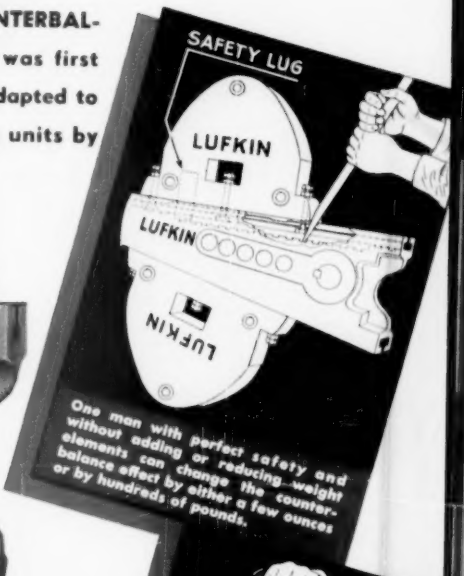

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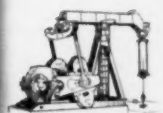

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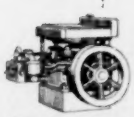

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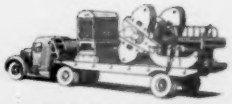

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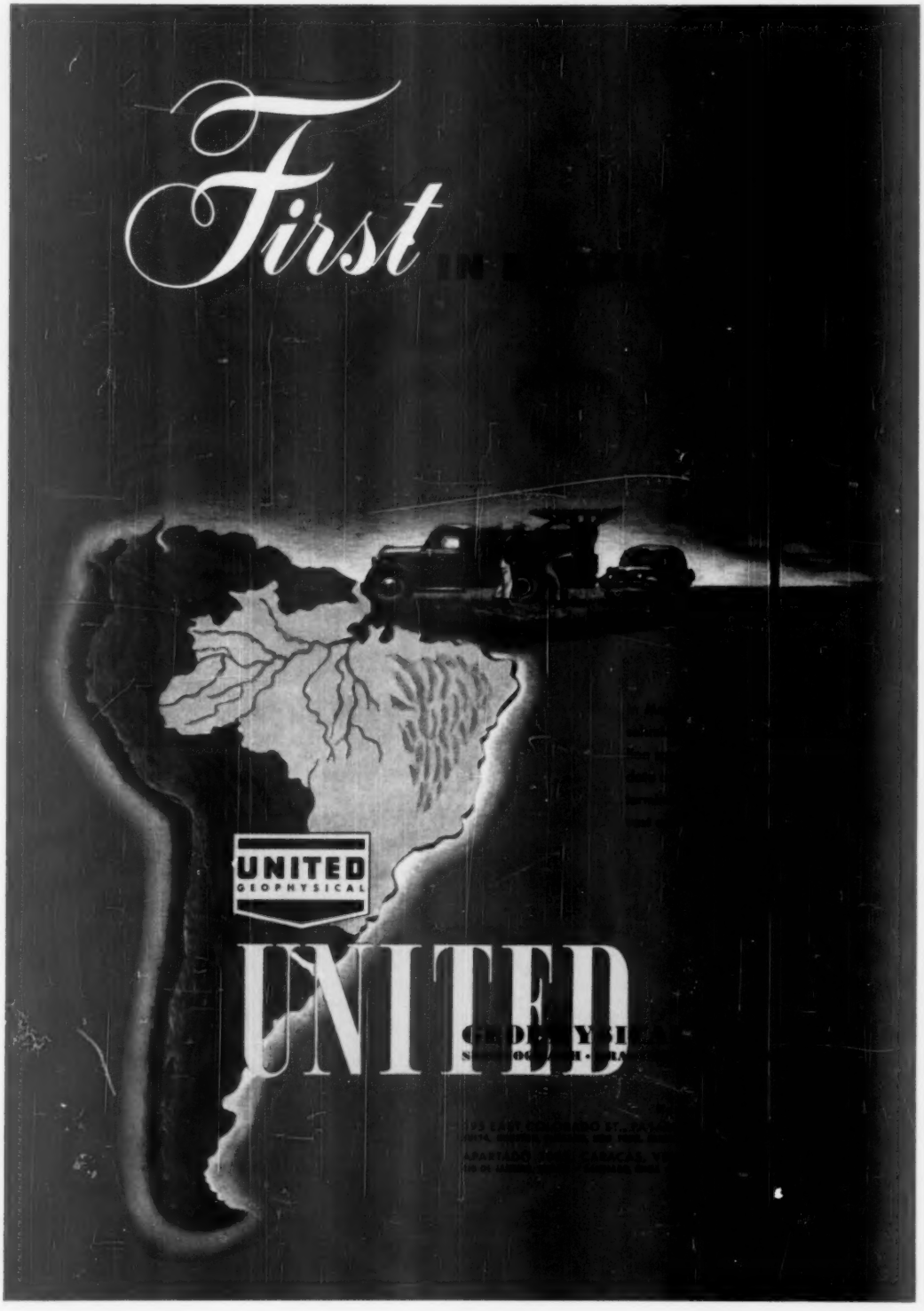
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